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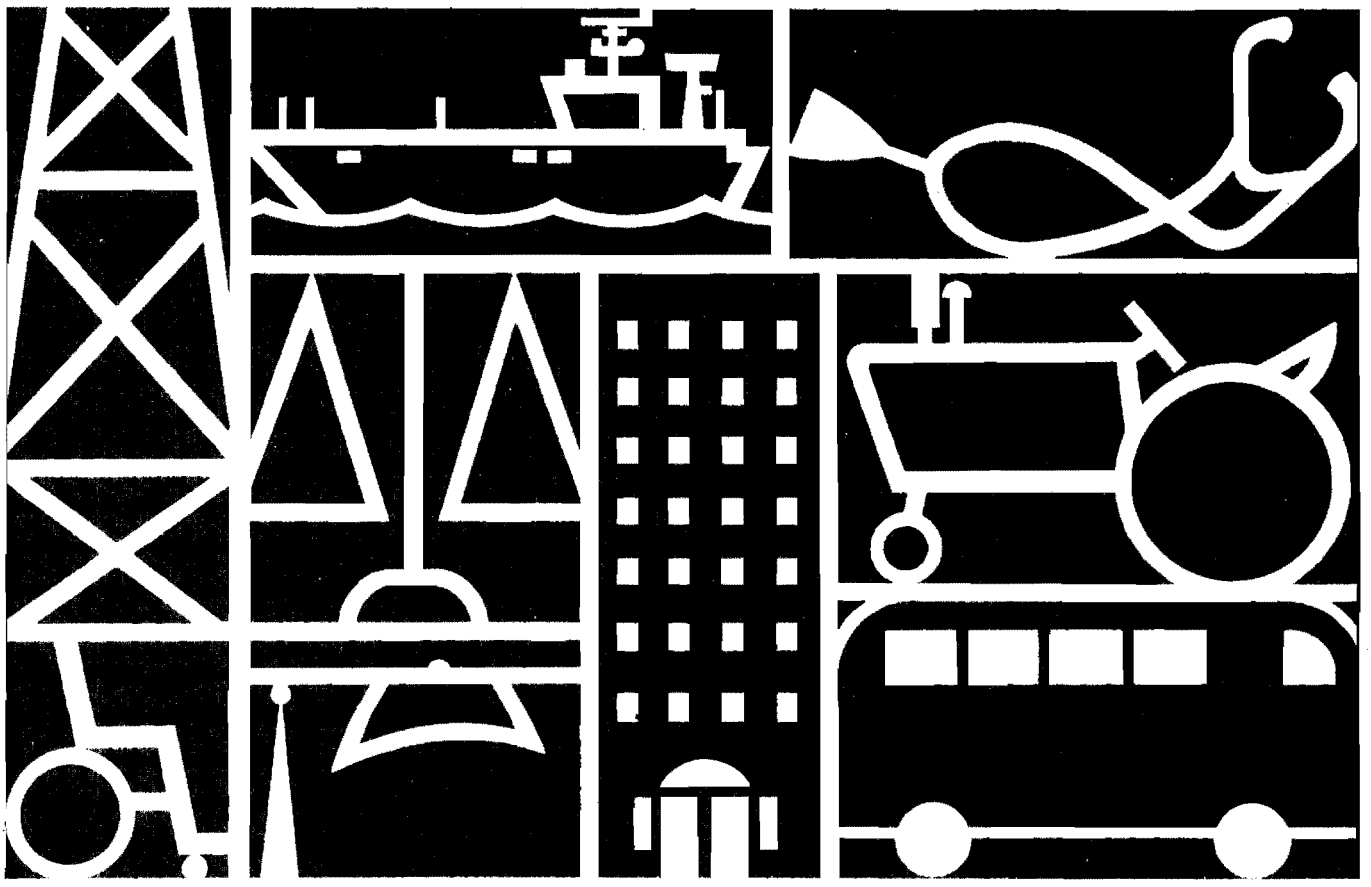

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NAVY BUDGET ISSUES
FOR FISCAL YEAR 1980

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PREFACE

As the Congress decides on budget targets for the First Concurrent Resolution on the Budget for Fiscal Year 1980, the appropriate size of the Navy budget will be one of the most important issues. Decisions about the size, location, and equipment of naval forces--both ships and aircraft--will be tied to assumptions about their use, both in wartime and in peacetime.

This budget issue paper devotes primary attention to the wartime missions of the general purpose Navy. (It draws upon a companion background paper that addresses the Navy's peacetime mission--overseas presence.) Responding to a joint request from the Senate Committee on the Budget and the Subcommittee on East Asian and Pacific Affairs of the Senate Committee on Foreign Relations, this paper examines the force and budgetary implications of alternate assumptions about Navy wartime and peacetime missions, with special reference to naval operations in the Pacific theater. In accordance with CBO's mandate to provide objective analysis, the paper offers no recommendations.

This paper was prepared by Dov S. Zakheim and Marshall Hoyler of the National Security and International Affairs Division of the Congressional Budget Office, under the general supervision of David S.C. Chu. The authors gratefully acknowledge the contribution of Edward Swoboda, who prepared the cost estimates, and Harold Furchtgott, who programmed the attack aircraft model used in this paper. Helpful comments on earlier drafts were provided by Patrick Renehan, Robert Schafer, Robert Hale, Andrew Hamilton, Hazel Denton, and Nancy Swope of the CBO staff and by General Robert J. Dixon, USAF (Ret.). (The assistance of external reviewers implies no responsibility for the final product, which rests solely with the Congressional Budget Office.) Patricia H. Johnston edited the manuscript; Janet Stafford typed it for publication.

Alice M. Rivlin
Director

March 1979

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SUMMARY

Annual Congressional decisions on programs for shipbuilding, conversion, and aircraft procurement affect the Navy's composition and budget for many years into the future. Not only do ships and planes take several years to build once they are authorized, but their service lives are often measured in decades. Since these items form the key portion of budgetary requests for naval programs, decisions on their levels also determine future demands for weapons, as well as levels of manpower, maintenance, and logistics support that will be required during their long service lives.

The fleet's size has declined dramatically in recent years, from more than 1,000 ships in 1970 to fewer than half that number today. At the same time, the Soviet threat to U.S. naval forces has intensified significantly. These changes have prompted widespread debate over the role and budget of the Navy: What missions should the Navy perform within the overall national defense strategy? And, within this context, how many and what types of ships and aircraft are required to support the fleet's capability to carry out these missions at the lowest cost?

In answering these questions, the Congress will face four major budgetary decisions in fiscal year 1980 and following years:

- Does the Navy require an additional aircraft carrier and, if so, how large and what kind should it be? The Administration has requested fiscal year 1980 funding for a mid-sized, conventionally powered aircraft carrier (CVV) to maintain current force levels. Some observers oppose procurement of any carrier; others advocate a large-deck, nuclear-powered unit (CVN); still others suggest a large-deck, conventional carrier (CV).

- Should the Congress fund a conventional AEGIS air defense destroyer (DDG-47) in fiscal year 1980? The Administration has requested $825 million to procure the second of a force of 12 DDG-47 AEGIS ships. (The first was funded in fiscal year 1978.) Some analysts favor a smaller AEGIS force level, however, while others prefer procurement of

nuclear-powered AEGIS cruisers (CGN-41) to support formation of five all-nuclear carrier task forces.

- Should the Congress fund programs to support the rapid introduction of V/STOL aircraft into the fleet? The Administration has budgeted less than $17 million for vertical/short take-off landing (V/STOL) aircraft programs in fiscal year 1980 and has effectively terminated the AV-8B Harrier V/STOL attack plane program. Supporters of the V/STOL concept maintain that only V/STOL technology will enable the Navy to deploy aircraft from a large number of smaller, less expensive ships and thereby increase force levels and flexibility and enhance fleet survivability. They support procurement of the Harrier for the Navy and/or increased funding for accelerated development of advanced V/STOL types, such as the V/STOL "B" supersonic attack plane.

- Should the Congress fund the Administration's fiscal year 1980 requests for 24 F-14 and 15 F/A-18 carrier aircraft at a cost of $666 million and $1,044 million, respectively? The F/A-18 program is planned to provide a less expensive aircraft (per program-unit) to perform many of the F-14's missions in other than high-threat conditions. It would also replace the A-7E attack aircraft currently in service. Some observers feel that the program should be increased at the expense of the more costly F-14; others prefer a larger F-14 force; still others view the F/A-18 program as an obstacle to the rapid introduction of V/STOL into the Navy's air arm.

Resolution of these budget issues depends on answers to three fundamental questions about the Navy's missions. The first is whether the Navy should have the capability to attack shore-based military installations in all contingencies, including a worldwide war with the Soviet Union ("offensive sea control"). In order to conduct such offensive operations, the Navy would have to enhance its strike-related forces, particularly its large-deck carriers and their fighter and attack aircraft squadrons. This would require purchasing an additional carrier to maintain the current force level of 12. Restricting naval offensive strategies to lesser contingencies and emphasizing sea-lane protection ("defensive sea control") in a major conflict might

call for less expensive carrier-related programs and greater procurement of less expensive fighter/attack aircraft.

A second question concerns the Navy's peacetime mission ("presence"). Even if offensive missions are not contemplated for all wartime contingencies, a case could be made for augmenting Navy strike forces by one additional aircraft carrier in order to maintain the current U.S. worldwide maritime posture. This posture emphasizes display and employment of strike forces to reassure allies of U.S. commitments, to deter actions that threaten U.S. interests, and to respond promptly to crises as they occur.

A final question involves the types of systems that might be best suited to carry out naval missions, however they are defined. Would the application of recent technological developments, such as the ability to take off and land vertically on small ships (V/STOL), be relevant to the U.S. Navy's needs?

CURRENT REQUIREMENTS--NAVY AND DoD VIEWS

The size of naval forces is determined by the primary demands of U.S. wartime strategy and by the residual demands of peacetime presence. For wartime missions, the Navy maintains it should be able to protect the sea-lanes in the Atlantic and Pacific Oceans both offensively and defensively and to defeat Soviet naval units in the Mediterranean Sea. The Navy considers that air power is critical to the success of these missions and that a force of 12 aircraft carriers is the minimum with which all missions can be carried out in a timely fashion.

Recent Navy analyses appear to suggest an allocation of seven carriers for defensive sea control operations in the Atlantic and Pacific Oceans and three more carriers for other tasks, notably offensive operations against Soviet bases. 1/ The Pacific ranks highest among the various locales in which the Navy contemplates

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1/ Two other carriers are assumed to be unavailable because of extended maintenance. An additional carrier would be undergoing service life extension. It would not be counted as part of the force of 12 operational carriers.

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the possibility of undertaking offensive sea control operations. The Navy argues that, by attacking Soviet bases in Asia, not only could it destroy potentially threatening Soviet forces, but it could also open up a "second front" in a worldwide war between NATO and the Warsaw Pact. The Navy states that it would need at least a 12-carrier force to conduct offensive attacks in the Pacific, while protecting sea-lanes elsewhere.

The Navy's peacetime requirement is subordinate to wartime demands. Nevertheless, the Navy states that no fewer than 12 carriers are needed to support its four permanent overseas stations, since allowance must be made for periods when carriers undergo extended maintenance or serve in training operations, as well as for the need to enable crews to spend no more than one-third of their duty on overseas deployment. Indeed, many states friendly to the United States view the effectiveness of U.S. presence in identical terms. For these reasons, the Navy favors maintaining the current permanent deployment of two carriers in the western Pacific and two in the Mediterranean.

Although the Department of Defense (DoD) supports the Navy's stated requirement for 12 aircraft carriers, it does not appear to share completely the Navy's supporting rationale. Instead of emphasizing the need for carriers to conduct offensive operations against shore installations in a major war with the Soviet Union, DoD stresses the need to maintain the current peacetime forward deployment of four carriers. DoD tends to support a defensive, sea-lane oriented strategy for naval forces in a major war and emphasizes offensive Navy operations only in the context of less demanding conflicts with non-Warsaw Pact countries.

REEXAMINING CURRENT REQUIREMENTS

Offensive sea control could involve high losses to carrier forces in light of the massed defenses deployed by the Soviet Union near its major bases. Furthermore, it might be argued that a war in which Soviet bases were attacked for purposes of offensive sea control would be unlikely to remain conventional. This observation is particularly applicable to the Pacific region, since Petropavlovsk, the major Soviet naval base with unrestricted access to the Pacific, services strategic ballistic missile submarines as well as general purpose units.

Moreover, an offensive strategy might not be needed in the Atlantic, since geographic chokepoints would enable allied air defense and antisubmarine warfare (ASW) systems to limit Soviet access to the Atlantic sea-lanes. Adding less costly land-based units for air defense or improving less costly ASW systems might be a more cost-effective approach to achieving sea control than offensive operations, such as attacks on Soviet bases, which would require high levels of carrier forces deploying expensive F-14 fighters and A-18 attack planes.

Peacetime presence also might not call for a sole reliance on carrier forces, especially since the current overseas posture may reflect a seriously inefficient deployment of carrier units. Only one carrier deploys at all times in the northwest Pacific, although Japan, Korea, and the People's Republic of China have become extremely apprehensive about the capabilities of Soviet naval units in that area. In contrast, the United States deploys a carrier force to the southwest Pacific and the Indian Ocean regions, areas in which the Soviet naval threat is much lower. A smaller ship carrying AV-8B V/STOL aircraft might be sufficient to respond to crises in these regions. It could, of course, be supplemented by carrier forces deployed elsewhere if necessary. In general, however, deployment of a V/STOL ship in the southwest Pacific/Indian Ocean regions in peacetime would permit redeployment of an additional carrier to the northwest Pacific.

U.S. interests in the Mediterranean appear to require continued presence to reassure allies and friends of the sincerity of U.S. commitments. The current carrier stations in the region may, however, enhance the ability of the Soviet Mediterranean units to carry out a damaging surprise attack on U.S. carrier forces. A feasible alternative approach could be more flexible deployment of carrier forces in the Mediterranean, although political constraints may prevent any changes to the current U.S. peacetime posture in that region.

Assumptions about U.S. naval missions also will affect choices about future aircraft construction. If offensive sea control in a major war is emphasized, only the F-14 could provide the enhanced air defense needed for this mission. On the other hand, if offensive missions are stressed only for lesser contingencies, the F-18 would be desirable because it is a more effective fighter escort than the F-14. Lastly, AV-8B Harrier V/STOLs could be procured if smaller ships capable of carrying

aircraft are preferred for some overseas presence operations. AV-8B procurement could also serve to accelerate the pace of supersonic V/STOL development. Currently, both the Navy and DoD support the eventual introduction of V/STOL. Accelerated V/STOL development might be desired, however, in order to enable the fleet to spread its offensive power among many small-deck ships and also, by adding air power to the fleet, to provide a hedge against the possible failure of the A-18 to meet expected performance requirements.

ALTERNATIVE APPROACHES TO NAVAL FORCES

Differing views about the Navy's missions in both wartime and peacetime are central to the fundamental choices regarding naval ship and aircraft procurement. In wartime, the choice is one between a Navy capable of conducting offensive operations against enemy land targets in all contingencies, including a war with the Soviet Union, and a Navy whose capabilities would restrict such operations to less demanding conflicts, while emphasizing sea-lane protection in a major war. In peacetime, the choice is between a Navy that would maintain the current carrier-centered role of permanent deployments and one that would reflect a more flexible posture with varying capabilities to respond to different threat levels in different locales. These alternate wartime and peacetime postures and their corresponding systems can be combined as shown in Table S-1; each option set is discussed below.

Option I: Defensive Wartime/Current Peacetime

The Congress could support the view that the primary role of the Navy in a major war is defensive protection of the sea-lanes and that the current peacetime presence posture should be preserved. To that end, it might approve the naval shipbuilding and aircraft budget proposed by the Department of Defense for fiscal year 1980. This would include funding for the CVV, a mid-sized, conventionally powered carrier whose primary purpose would be to permit the Navy to maintain its four permanent overseas carrier stations. It would also include procurement of another DDG-47 (part of a planned total of at least 12 AEGIS destroyers), to correspond to the number of operational carriers in the fleet, and a mix of F-14/F-18 and A-18 aircraft, to provide for defense of the fleet in a major war and to enhance attack

TABLE S-1. COMPONENTS OF ILLUSTRATIVE OPTIONS

	Options			
	I	II	III	IV
Wartime Missions	Defensive	Defensive	Offensive	Offensive
Peacetime Posture	Unchanged	Altered	Altered	Unchanged
Weapons System Characteristics				
New Carrier a/	Conventional/ mid-sized	None b/	Conventional/ large- b/ deck	Nuclear
Aircraft a/	CTOL only	CTOL/VSTOL	CTOL/VSTOL	CTOL only

a/ Includes conversion of amphibious ships to small-deck aircraft carriers.

b/ See Table S-4 for details of the aircraft in each option.

aircraft survivability in a lesser contingency. The investment cost of this option would be $4.2 billion for fiscal year 1980 and $21.7 billion for fiscal years 1980-1984 (see Tables S-2 and S-3).

Option II: Defensive Wartime/Altered Peacetime

The Congress could, however, determine that not only should naval forces adopt primarily a defensive posture when protecting the sea-lanes in a major war, but that the Navy's peacetime

requirement for naval presence could be accomplished with less capable ships or fewer permanent deployments. In that case, the Congress could approve a program that would procure no carrier or AEGIS ship in 1980 but would procure eight AEGIS ships in the ensuing four fiscal years (for a total purchase of nine units). This option would also convert two LPH amphibious assault ships into V/STOL carriers. It would purchase fewer of the more costly F-14s but would procure eight squadrons of F-18s in place of the currently programmed six squadrons. It would replace the A-7E with the A-18 for air attack operations and provide AV-8B aircraft for the V/STOL ships. The investment cost of this option would amount to $2.2 billion in fiscal year 1980 and about $18.9 billion for fiscal years 1980-1984.

Option III: Offensive Wartime/Altered Peacetime

Alternatively, the Congress could accept the Navy's view that offensive operations are critical to the success of the sea control mission--particularly in the Pacific, where there are fewer geographic barriers to Soviet access to the sea-lanes--but still feel that the Navy should alter its peacetime deployment posture so as to derive greater benefit from the flexibility inherent in naval forces. To that end, the Congress could authorize procurement of a large-deck, conventionally powered carrier; conversion of two amphibious assault ships (LPH) into V/STOL carriers; and procurement of another DDG-47 AEGIS destroyer (as part of the planned force of at least 12 units). It could also authorize funds for military construction to permit the homeporting of an LPH in Guam. This option would include procurement of an all F-14 and an all A-18 force for the conventional carriers to enhance fleet air defense and ground attack capabilities. It would also include procurement of AV-8B attack aircraft for the LPHs.

This ship and aircraft program would enable the Navy to mount strike operations against Soviet bases in wartime and to raise the profile of its deployments in the northwest Pacific in peacetime. It would also allow for continuation of the current level of deployments in the southwest Pacific, though with less capable ships, which could be supplemented as necessary by the large-deck force without serious disruption of other deployment commitments. The investment cost of this program

would amount to $5.2 billion for fiscal year 1980 and $26.7 billion for fiscal years 1980-1984.

Option IV: Offensive Wartime/Current Peacetime

Lastly, the Congress might favor a wartime offensive mission for the Navy but might not be convinced of the effectiveness of V/STOL operations in the immediate future. It might also prefer to maintain the current peacetime deployment posture. The Congress could then authorize procurement of a large-deck, nuclear-powered carrier, together with five nuclear-powered escorts (CGN-41), to permit creation of five all-nuclear task forces. It could also authorize seven conventionally powered AEGIS destroyers to support the remainder of the carrier force.

As with the preceding option, an emphasis on offensive operations would call for procurement of the most capable interceptor and attack aircraft force, F-14 and A-18 squadrons for all 12 carriers. On the other hand, AV-8B aircraft would not be procured. The investment cost of this option would amount to $6.4 billion in fiscal year 1980 and $25.7 billion in fiscal years 1980-1984.

Choosing Among the Options

The options outlined above are illustrative of the procurement choices that derive from alternative views of mission requirements. The options highlight the importance of assigning priorities to naval missions and, therefore, to naval programs. In assigning these priorities--between offensive and defensive wartime missions and between current and altered peacetime postures--the Congress not only will determine current shipbuilding and aircraft procurement levels, but also will affect the overall level of Navy budgets and capabilities for the remainder of this century.

TABLE S-2. U.S. NAVAL FORCE OPTIONS FOR FISCAL YEAR 1980: COSTS IN MILLIONS OF FISCAL YEAR 1980 DOLLARS

	Options			
	I	II	III	IV
Posture	Defensive/Wartime Current/Peacetime	Defensive/Wartime Altered/Peacetime	Offensive/Wartime Altered/Peacetime	Offensive/Wartime Current/Peacetime
Ships Procured/ Converted	CTOL Carrier: CVV (1) -- DDG-47 (1) —	— V/STOL Carrier: LPH Conversion (1) — --	CTOL Carrier: CV (1) V/STOL Carrier: LPH Conversion (1) DDG-47 (1) —	CTOL Carrier: CVN (1) — DDG-47 (1) CGN-41 (1)
Aircraft Procured	F-14 (24) F/A-18 (15) —	F-14 (24) F/A-18 (15) AV-8B (Dev)	F-14 (44) A-18 (15) AV-8B (Dev)	F-14 (44) A-18 (15) --
Other Programs	V/STOL R&D —	V/STOL R&D Milcon/Guam	V/STOL R&D Milcon/Guam	V/STOL R&D —
Cost: Fiscal Year 1980	$4,226	$2,162	$5,226	$6,432

TABLE S-3. U.S. NAVAL FORCE OPTIONS FOR FISCAL YEARS 1980-1984: COSTS IN MILLIONS OF FISCAL YEAR 1980 DOLLARS

	Options			
	I	II	III	IV
Posture	Defensive/Wartime Current/Peacetime	Defensive/Wartime Altered/Peacetime	Offensive/Wartime Altered/Peacetime	Offensive/Wartime Current/Peacetime
Ships Procured/ Converted	CTOL Carrier: CVV (1) — CV/SLEP (2) DDG-47 (10) —	— V/STOL Carrier: LPH Conversion (2) LHA (1) CV/SLEP (2) DDG-47 (8) —	CTOL Carrier: CV (1) V/STOL Carrier: LPH Conversion (2) LHA (1) CV/SLEP (2) DDG-47 (10) —	CTOL Carrier: CVN (1) — CV/SLEP (2) DDG-47 (6) CGN-41 (5)
Aircraft Procured	F-14 (120) F/A-18 (453) —	F-14 (24) F/A-18 (399) AV-8B (90)	F-14 (220) A-18 (399) AV-8B (90)	F-14 (220) A-18 (453) —
Other Programs	V/STOL R&D —	V/STOL R&D Milcon/Guam	V/STOL R&D Milcon/Guam	V/STOL R&D —
Cost: Fiscal Years 1980-1984	$21,653	$18,882	$26,749	$25,743

TABLE S-4. 1995 FORCE LEVELS RESULTING FROM ALTERNATE BUDGET OPTIONS

	Options			
	I	II	III	IV
Active CTOL Carriers				
Large-Deck Nuclear-Powered Carriers	4	4	4	5
Large-Deck Conventional Carriers	7	7	8	7
Mid-Sized Carriers	1	-	-	-
Total Active CTOL Carriers	12	11	12	12
V/STOL Carriers	-	2	2	-
Conventional AEGIS Escorts	12 a/	9	12 a/	7
Nuclear AEGIS Escorts	-	-	-	5
F-14 Carrier Wing Equivalents	9	7	12	12
F-18 Carrier Wing Equivalents	3	4	-	-
AV-8B V/STOL Carrier Wings	-	2	2	-

a/ Assumes additional DDG-47 procurement after fiscal year 1984.

CHAPTER I. INTRODUCTION

Each year the Congress is asked to act upon a budget request for naval programs that amounts to almost one-third of the entire Department of Defense (DoD) budget. The most critical portion of that request comprises two subsections of the Navy's procurement account: shipbuilding and conversion (SCN) and aircraft procurement (APN). Annual decisions on the procurement of new ships and aircraft for the Navy can determine future demands for weapons and supporting systems as well as the necessary levels of manpower and maintenance during their long service lives. 1/

The lead times associated with procurement of new systems for the fleet are quite long. In some cases, nearly a decade may elapse between the time the Congress funds a ship's construction and the time the ship enters the fleet. Once these systems are completed, however, they will remain in operation for an even longer period. Aircraft have an operating life of about 15 years. Most ships will operate 20 to 30 years; the largest combat and support ships will operate 35 years or more. Thus, Congressional decisions with respect to a given year's procurement accounts will affect the Navy's composition, and its budgets, for decades to come.

The fleet's size has declined dramatically in recent years, from over 1,000 ships in 1970 to fewer than half that total today. The cost of ships in current-dollar terms has risen equally as dramatically. Individual surface units, for example, will require at least twice the funding in fiscal year 1980 as they did a decade ago.

1/ These requirements are dealt with in the following budget accounts:

WPN - Weapons Procurement, Navy
OPN - Other Procurement, Navy
MPN - Military Personnel, Navy
O&MN - Operations and Maintenance, Navy.

At the same time, the Soviet threat to U.S. naval forces has intensified significantly in the past ten years. The Soviet Union operates a large number of modern offensive naval systems worldwide, has developed a sea-based naval air arm, and has demonstrated its worldwide command and control capabilities in a series of highly successful fleet exercises.

These changes have imparted a sense of urgency to recent Congressional debates over Navy budget submissions. They have also prompted widespread debate outside the Congress, particularly within the Navy itself. It is widely recognized that the continuing debate over funding Navy programs actually concerns the more fundamental problem of the Navy's future through the remainder of the century: What are the missions that the Navy should perform within the overall national defense strategy? Given the long service lives of current fleet assets, how many and what kinds of new ships and aircraft must be procured to support the fleet's capability to carry out those missions at the lowest cost?

It is in terms of their mission requirements, their marginal contributions to those requirements, and the costs of those contributions that this paper will address four major sets of procurement issues that are likely to be at the center of the Navy budget debates in fiscal year 1980 and beyond.

- Does the Navy require an additional aircraft carrier and, if so, how large should it be?
- Should the Congress fund a conventional AEGIS destroyer (DDG-47) in fiscal year 1980?
- Should the Congress fund programs supporting the rapid introduction of V/STOL aircraft into the fleet?
- Should the Congress fund the Administration's fiscal year 1980 requests for 24 F-14 and 15 F/A-18 aircraft at a cost of $666 million and $1,044 million, respectively?

Need for and Size of an Additional Aircraft Carrier. The question of the aircraft carrier's future role in U.S. Navy operations has dominated recent Congressional debates on the Navy's budget and has divided naval analysts and officers. The size of the carrier force has declined from 23 units in 1968

to 13 today. Its unit costs exceed those of any other single item in the DoD budget. Although its capabilities exceed those of any other ship, the carrier is threatened by the development of Soviet cruise missile capabilities.

President Carter vetoed the fiscal year 1979 defense authorization bill primarily because it included $2.1 billion to fund procurement of a large-deck, nuclear-powered aircraft carrier. The President argued that a nuclear-powered carrier would not contribute sufficient additional capabilities to the fleet to justify its cost. In fiscal year 1980, the Administration is asking the Congress to fund procurement of an additional aircraft carrier for the fleet, but it will be a smaller, conventionally powered, mid-sized carrier (a CVV), costing $1.6 billion (in fiscal year 1980 dollars). This request is geared to maintaining a constant 12-carrier force level through the year 2000. It raises the question of whether the ship's contribution to fleet capabilities justifies its cost. The Congress may wish to consider the contribution of other programs that would more efficiently meet the demands of current naval missions. Such programs could include large carrier variants such as a nuclear-powered CVN or a conventionally powered large-deck ship (CV). Alternately, they could involve smaller ship types and additional homeporting arrangements. Large carrier alternatives would exceed the cost of the mid-sized carrier; some of the other alternatives could amount to less than half its cost.

A Conventional AEGIS Destroyer (DDG-47) in Fiscal Year 1980. The Administration has requested $825 million (in fiscal year 1980 dollars) for a DDG-47. This will be the second of a class of at least 12 ships, each of which will support a carrier task force. Both AEGIS and its prospective platforms have been the subject of considerable debate since the early 1970s. The system is meant to provide area air defense for major fleet units against multiple attackers. It reportedly can track, target, and attack more incoming missiles or aircraft than any other system currently in operation or under development. Some observers have questioned the need for AEGIS in all situations, however, particularly given the combined cost of the system and its platform. They have pointed to less costly alternatives that involve modernizing currently deployed Terrier and Tartar shipboard air defense systems. Others, on the other hand, have stressed the need to deploy AEGIS aboard nuclear-powered ships. They have argued that the nuclear-powered AEGIS ship should receive priority

over its conventionally powered destroyer counterpart. Programs to construct such ships--notably the strike cruiser (CSGN)--have never passed the Congress, however, despite strong support in each of the past six years from the House Armed Services Committee. The Congress did vote fiscal year 1977 funds to backfit AEGIS onto the nuclear-powered cruiser Long Beach but, at the urging of the Carter Administration, rescinded the funding in 1977. The five-year plan for fiscal years 1979-1983 reduced the proposed purchase of nuclear-powered AEGIS ships to one unit, a follow-on Virginia-class cruiser (CGN), and relegated the procurement to the last year of the plan. The current plan includes no provision for any nuclear AEGIS ship variant.

Programs to Support the Rapid Introduction of V/STOL Aircraft. The development of an airplane that can take off or land vertically or from a short deck run (V/STOL) without the assistance of shipborne catapults offers the opportunity to operate aircraft from ships considerably smaller than the large-deck carrier. Supporters of the V/STOL concept have argued that only V/STOL technology will permit the Navy to deploy aircraft from large numbers of smaller, less expensive platforms, and thereby increase fleet force levels and survivability. The costs of large-deck carriers and anticipated constraints on naval budgets will, in their view, prevent any similar expansion of carrier force levels. A number of foreign states have procured these aircraft, as well as specially designed ships to carry them.

The program to introduce V/STOL into the fleet at the earliest possible time has attracted considerable support in the Congress. The Congress authorized fiscal year 1979 funds for conversion of amphibious helicopter ships to V/STOL carriers to support a variant of the Harrier V/STOL attack plane. It also voted funds above the Administration request to accelerate development of a more capable Harrier V/STOL plane (AV-8B) for the fleet. Neither the Administration nor the Navy assigns the same priority to the V/STOL program, however, though both anticipate the eventual introduction of V/STOL for Navy operations. The Administration veto of the fiscal year 1979 authorization effectively ended V/STOL ship initiatives for that year. The fiscal year 1980 request contains only $5.7 million for the AV-8B advanced Harrier, virtually terminating the program, and includes only $16.8 million for other V/STOL development.

The Congress may wish to assess whether U.S. maritime needs for V/STOL planes are sufficiently urgent at present to call for introduction of the AV-8B into the fleet and whether small ships should be procured specifically to carry these aircraft. The Congress could also press for the earliest possible introduction of a supersonic V/STOL plane (V/STOL-B) into the fleet. In so doing, it could increase funding for research and development to accelerate current V/STOL programs in order to introduce an operational V/STOL-B before 1995--the date currently projected for initial operational capability. A Congressional decision in favor of an accelerated V/STOL program will influence both aircraft and shipbulding programs not only in fiscal year 1980, but in fiscal years 1981-1984 as well.

The Administration's Fiscal Year 1980 Requests for 24 F-14 and 15 F/A-18 Aircraft. Regardless of a decision on procurement of an additional aircraft carrier, the Navy will continue to operate a large number of these ships for at least the next 20 years. The Administration is requesting the Congress to fund an additional 24 F-14 aircraft at a cost of $666 million, which represents part of the total purchase of these planes that began in fiscal year 1972, and that will eventally provide 18 F-14 squadrons for the fleet. It also is requesting funds for 15 F/A-18 fighter/attack planes at a cost of $1,044 million. The first five production aircraft were funded in fiscal year 1979, and the total program, which will exceed 1,000 planes, will not be completed until the 1990s. The F/A-18 duplicates, at varying levels of effectiveness, the missions of the F-14 interceptor and A-7 attack plane. Developed as a lower-cost alternative to the F-14, the F/A-18 is capable of operating in other than the most demanding environments. Because the same airframe could serve, with minor modifications, as both a fighter and attack plane, it also was developed as a replacement for the A-7. The F/A-18 has been viewed as an obstacle to accelerated V/STOL development, however, since deployment of the A-18 would meet requirements for naval attack aircraft at least until the late 1990s, at the earliest. It also has been opposed by supporters of the F-14, who prefer that plane for all naval fighter missions. The fiscal year 1980 request offers the Congress the opportunity to evaluate again the demand for F-14s and F/A-18s not only in light of mission requirements, costs, and capabilities, but also in terms of the importance it attaches to naval V/STOL programs.

This budget issue paper represents the most recent of a series of Congressional Budget Office studies on maritime force issues. 2/ It focuses on the link between naval aviation alternatives relating to air superiority and ground-attack mission requirements and decisions about shipbuilding budgets. 3/

The paper examines naval force missions, requirements, and programs from three perspectives:

- o A worldwide war with the Soviet Union;
- o A lesser contingency that might involve Soviet forces; and
- o Peacetime naval deployments.

Chapter II reviews the missions that arise out of each of these perspectives and the air and sea forces that the Navy devotes to those missions in each of its major operating areas: the Atlantic, Pacific, and Indian Oceans and the Mediterranean Sea. Chapters III and IV reexamine the demands those missions place upon fleet capabilities and the implications for fleet requirements if the priorities attached to those missions are varied. Chapter III focuses on issues relating to ship platforms, notably air-capable units such as the aircraft carrier. Chapter IV addresses issues relating to tactical air operations.

2/ Congressional Budget Office, U.S. Naval Force Alternatives, Staff Working Paper (March 1976); Planning U.S. General Purpose Forces: The Navy, Budget Issue Paper for Fiscal Year 1978 (December 1976; Reprint, July 1978); The U.S. Sea Control Mission: Forces, Capabilities, and Requirements, Background Paper (June 1977); U.S. Projection Forces: Requirements, Scenarios, and Options, Budget Issue Paper for Fiscal Year 1979 (April 1978); Planning U.S. General Purpose Forces: Forces Related to Asia, Budget Issue Paper for Fiscal Year 1978 (June 1977).

3/ The paper leaves for future discussion the role of aviation for antisubmarine warfare and the role of Marine aviation, although both issues are important elements in discussions of the U.S. maritime posture.

Chapter V presents illustrative budget options for both fiscal year 1980 and the five fiscal years 1980-1984 that tailor ship and aircraft procurement programs to different sets of mission priorities. The chapter then examines individual elements of those options that, apart from the larger questions of missions or roles, might be evaluated on their own merits.

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CHAPTER II. MISSIONS AND NAVAL FORCE REQUIREMENTS

Naval forces fulfill two major wartime missions within the national forward defense strategy: sea control and power projection. Sea control involves protecting friendly shipping along sea lines of communication between the United States and her overseas forces and allies and denying their use to enemy forces. In carrying out its sea control mission, the Navy must reduce enemy submarine, bomber, and surface ship 1/ activity to a level that will not seriously impede the use of the sea-lanes by friendly forces. To carry out this mission, the Navy might operate "defensively," providing protection for friendly units in or near the sea-lanes themselves, or "offensively," employing air or ground units to attack the bases from which enemy units might deploy.

The second major wartime mission, power projection, is akin to "offensive sea control." Power projection in conventional warfare denotes the Navy's ability to launch sea-based air attacks, support ground attacks, and provide gunfire against enemy targets onshore.

In addition to the wartime sea control and power projection missions, the Navy has the peacetime function of supporting U.S. presence overseas. Its presence role is, however, closely linked to the wartime projection mission. Forward-deployed naval units can quickly and easily undertake wartime operations against an adversary without the encumbrance of third-country constraints (such as landing or overflight rights). For this reason, the Navy has been a particularly useful instrument for carrying out both aspects of the presence mission, "showing the flag" (or expressing

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1/ This antisurface warfare (ASUW) element of sea control is often overlooked. Nevertheless, a primary role of carrier-based attack aircraft is to perform ASUW. See statement of Admiral James L. Holloway III, in Military Posture and H.R. 10929 (Department of Defense Authorization for Appropriations for Fiscal Year 1979), Hearings before the House Committee on Armed Services, 95:2 (February, March, and April 1978), Part 1, pp. 661, 742-43.

U.S. interest in a region) and "crisis control" (or acting as an intermediary to reduce tensions between other states).

The sea control and power projection missions formally take precedence over any peacetime Navy functions, and sea control is given priority over power projection. 2/ Nevertheless, presence is an important factor in determining the size and deployment of naval forces, while projection has been the most common naval wartime operation since the end of World War II.

THE NAVY'S MISSIONS AND THE DEVELOPMENT OF SOVIET MARITIME POWER

While the Navy has not had to fight for control of any ocean since World War II, the development of Soviet naval capabilities underscores the importance of sea control as a Navy mission. In the years following World War II, the Soviet navy was capable of conducting little more than coastal defense operations. Since the early 1960s, however, Soviet maritime forces have undergone considerable improvement. They now have the potential to threaten U.S. naval units in most of the world's seas. Soviet maritime forces include a modernized naval air force, whose newest addition is the long-range Backfire bomber. They also include a force of 243 submarines, of which 85 units are nuclear powered, 3/ and a surface Navy that boasts several units with antiship capabilities as well as two medium-sized aircraft carriers capable of launching vertical take-off and landing (VTOL) planes.

Soviet air, surface, and submarine capabilities are expected to improve further during the remainder of the century. The Backfire is expected to replace all other bombers in the Soviet Naval Air (SNA) force and will number some 225 units, with a like number in the Long Range Aviation (LRA) force (some of which could also be applied to maritime missions). 4/ It is anticipated

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2/ Ibid., p. 660.

3/ International Institute for Strategic Studies, The Military Balance, 1978-1979 (London: 1978), p. 9; Jane's Fighting Ships, 1978-79.

4/ Bill Sweetman, "Backfire - The Bogeyman Bomber," Flight International (December 17, 1977), p. 1815.

that the Il-86 tanker, recently introduced in the Soviet air fleet, could serve to refuel Backfire, increasing its range by about 50 percent. 5/ Further, the Soviet Union is developing the AS-6 missile, with an estimated operational range of about 150 miles; Backfire could carry two of these missiles. 6/ Lastly, Backfire may itself begin to be replaced in the 1990s by a still more capable bomber, whose appearance in the Long Range Aviation force is anticipated in the early 1980s as a replacement for Badger aircraft. 7/

The Soviet submarine forces likewise are expected to undergo further modernization in the next two decades, although the pace of modernization is extremely difficult to predict. 8/ In

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5/ Peter Borgart, "USSR Develops New Il-86 Variants," International Defense Review (July 1978), p. 1015.

6/ Sweetman, "Backfire," p. 1814.

7/ Bonner Day, "Soviet Bombers: A Growing Threat," Air Force Magazine (November 1978), p. 87. See also Clarence A. Robinson, Jr., "Soviets Developing Two Bombers, Extending Range of Backfire," Aviation Week and Space Technology (February 18, 1979), p. 14. The Backfire bomber first entered the Soviet inventory in 1974 and is currently being produced at a rate of 30 per year. See William D. O'Neil, "Backfire: Long Shadow on the Sea Lanes," United States Naval Institute Proceedings (March 1977), p. 28; and Jane's All the World's Aircraft, 1978-79. Assuming a 20-year service life for the Backfire bomber, the first replacement aircraft for the 30 oldest units would be required in the 1989-1994 period.

8/ Expectations that a quieter, advanced "third-generation" submarine would enter the fleet in 1978 were based on the delivery of a prototype Alpha submarine from the Sudomekh yard in 1970. See Michael MccGwire, "Soviet Naval Programs," in Michael MccGwire and John McDonnell, eds., Soviet Naval Influence: Domestic and Foreign Dimensions (New York: Praeger, 1977), p. 340. No serial production appears to have begun, however, although Alpha continues to be considered as the prototype for the new submarine. See Jane's Fighting Ships, 1978-79.

any event, continued replacement of older types with nuclear-powered, Charlie-class submarines carrying cruise missiles and with nuclear-powered, Victor-class submarines carrying torpedos will incrementally enhance Soviet submarine capabilities in terms of range, speed, and firepower.

The most dramatic change in the Soviet surface fleet has been the appearance of the Kiev-class aircraft carriers, which displace 37,000 tons and carry 35 VTOL aircraft. These carriers could be added at the rate of one every three years, 9/ potentially resulting in a fleet of ten by the end of the century. In addition, the Soviet Union is likely to improve upon its current VTOL aircraft's performance, possibly providing it with a short take-off capability that would add to its range and payload. 10/

While improvements in Soviet capabilities do not indicate how their forces might be employed, they do point to the greater Soviet potential for disrupting or preventing successful U.S. fleet operations both in wartime and in peacetime. The Navy contends that these developments can best be countered by preserving the current primacy of the aircraft carrier and its wing, its most capable system, in the U.S. fleet of the 1980s and 1990s. 11/

THE CARRIER AND ITS AIR WING: FORCES AND CAPABILITIES

The multiple capabilities of the carrier aircraft wing--and, in particular, the long-range offensive firepower that it can generate--have made the carrier a critical element both in the Navy's wartime sea control and projection missions and in its peacetime operations. The missions of carrier aircraft have changed over the past three decades. In the years following World War II, carriers were a key element of the U.S. nuclear deterrent: planes armed with nuclear bombs were assigned targets in the Soviet Union. The carrier's strategic nuclear role was downgraded

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9/ Norman Polmar, "Soviet Naval Aviation," Air Force Magazine (March 1978), pp. 67-78.

10/ Ibid.

11/ See "USN Aircraft Carrier Programs: Topical Questions and Answers," in Military Posture and H.R. 10929, Hearings, Part 4, pp. 399, 403-4, and 413-14.

during the 1960s. At the same time, carriers conducted conventional power projection missions, particularly during the Vietnam War. Currently, Navy budget requests emphasize the importance of the carrier in a non-nuclear worldwide conflict with the Soviet Union, in addition to stressing its importance for limited contingencies and peacetime presence.

The aircraft carrier performs several defensive tasks in addition to providing much of the Navy's offensive capability. In the past, the carrier force was divided into antisubmarine (CVS) and attack (CVA) carrier units, with specialized air wings for each. As the older, less capable, specialized carriers were phased out of the force, they were replaced by multimission carriers and air wings capable of both attack and antisubmarine roles. These wings include interceptors and attack, support, and antisubmarine units. 12/

The fleet currently numbers 13 carriers, with an air wing for 12 of them. The carrier air wings are structured to perform both the Navy's sea control and power projection missions and can be tailored to enhance the carrier's ability to meet the demands of either task.

The sea control mission requires both antisubmarine warfare (ASW) and anti-air warfare (AAW) capabilities. Specialized fixed-wing and helicopter aircraft are important for the ASW function. AAW requires primarily radar early-warning aircraft, interceptors, and tankers. The power projection mission requires not only attack aircraft, but also ASW and AAW capabilities for carrier defense. Escorting fighters and electronic warfare aircraft are also useful in power projection as a means of defeating enemy interceptors and other electronically directed defensive systems.

Although the Navy has air wings of roughly the composition described above for 12 of its 13 carriers, it has many more planes available to support each wing. These additional aircraft mean that carrier air wings could be supplemented by Navy aircraft operating from land bases at the outset of a

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12/ U.S. Department of Defense, Annual Report for Fiscal Year 1976 and 197T, pp. III-79, III-81.

war. 13/ In fact, even the planes assigned to some active carrier air wings might fall within this category, since two carriers are likely to be in overhaul at any time, thus freeing their aircraft for deployment elsewhere. 14/

Influence of the Carrier on the Fleet

The carrier has strongly influenced the size, structure, and composition of the fleet. Carriers require escorts for protection, replenishment ships to sustain long-distance operations, and a variety of support ships for at-sea repair work. In all, the current carrier force needs an estimated 179 additional ships to support carrier operations. 15/

Escort forces comprise the largest category of units directly associated with carrier operations. The escort force has amounted to no less than 35 percent of all general purpose naval assets since World War II. Escorts traditionally have been defensive units since the days of battleship task forces. 16/ They currently provide the carrier with area air defense protection and short-range antisubmarine protection. With the introduction of the Harpoon surface-to-surface missile, U.S. escorts also will acquire a significant antiship capability. AAW and ASW

13/ These aircraft are discussed in Chapter IV.

14/ Aircraft from carriers in overhaul should not be confused with aircraft in overhaul, which, like the carriers, would not immediately be available for combat. The Marine Corps also operates A-6 and A-4 carrier-capable attack and F-4 fighter aircraft. Some of these units could also be applied to the demands of naval missions (see Chapter III).

15/ See Congressional Budget Office, U.S. Naval Forces: The Peacetime Presence Mission, Background Paper (December 1978), p. 81.

16/ Christopher Harvie, "Technological Change and Military Power," in New Conventional Weapons and East-West Security, Part I, Adelphi Paper No. 144 (London: International Institute for Strategic Studies, 1978), p. 9.

requirements, however, continue to be the primary considerations when sizing escort levels for carrier task forces. 17/

The degree to which carrier force levels and missions affect escort needs is illustrated by current discussions about the appropriate size of the DDG-47 destroyer force. The DDG-47 is a conventionally powered, 8,900-ton destroyer that is programmed to carry the AEGIS air defense system. This system will significantly improve U.S. AAW capabilities against the modernized Soviet antiship bomber force. The AEGIS system will enhance carrier survivability against potentially large Backfire raids because of its ability both to track and to target a large number of enemy units simultaneously and to control refirings automatically in far less time than current Terrier and Tartar AAW systems permit. 18/

The current program calls for at least 11 DDG-47 escorts at a cost of $820 million (fiscal year 1980 dollars) for each additional ship. Twelve ships would provide each carrier with one AEGIS escort. 19/ There has been some discussion of buying additional DDG-47s, however, to permit greater AEGIS coverage for

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17/ Current additions to the Soviet surface fleet have more range and seakeeping capability than the units they are replacing. Nevertheless, the Soviet surface fleet is unlikely to challenge U.S. forces in regions remote from Soviet air cover. A partial exception is the Mediterranean, where Soviet fighter air cover may not be available, but where a preemptive attack on U.S. forces could include bomber operations. See U.S. Department of the Navy, Sea Plan 2000, Executive Summary, Unclassified (March 28, 1978), p. 15 and Chapter III of this paper.

18/ See Alva M. Bowen and Michael Krepon, AEGIS Weapons System: Ship Selection and Related Issues, Congressional Research Service (1977), pp. 9-12.

19/ Navy testimony in support of the fiscal year 1978 program indicated a minimum requirement of one AEGIS system per carrier task group. See testimony of Vice Admiral James H. Doyle, Jr., in Military Posture and H.R. 10929, Hearings, Part 4, pp. 313, 318.

carrier operations in high-threat areas. 20/ Both approaches to the size of the DDG-47 program link DDG-47 levels to carrier requirements. Thus, alterations in the size and missions of the carrier force could justify changes in the current or proposed DDG-47 program.

SETTING CARRIER FORCE LEVEL REQUIREMENTS

The Navy's 13-carrier force will soon decline to 12 carriers when the oldest carrier is retired. Unless another carrier is procured, the operational force will decline still further to 11 units once carriers begin to undergo long-term "service-life extension" modifications. The Navy supports the acquisition of an additional carrier to bring the level to 12 operational carriers, arguing that a 12-carrier force is the minimum level with which it could hope to achieve all of its wartime missions with some assurance of success. 21/ In terms of peacetime operations, the Navy similarly argues that 12 operational carriers are the minimum level required to support the four overseas carrier stations it currently maintains in the Pacific Ocean and Mediterranean Sea.

20/ Ibid., p. 318.

21/ The Navy often alludes to a larger force level, termed the "prudent risk" carrier force. This force, estimated at 16 ships, would enable the Navy to carry out a larger number of its wartime missions simultaneously in the Atlantic, Pacific, and Indian Oceans and in the Mediterranean Sea (described below). Not all of those missions need be carried out simultaneously, however. For example, combat in the Mediterranean would likely take place early in a war, since the Sixth Fleet and a large Soviet Mediterranean squadron operate in close proximity there. On the other hand, protection of oil routes in the Indian Ocean will not be a pressing requirement until allied oil stocks are depleted later in the conflict. On prudent-risk force requirements, see Alva M. Bowen, Jr. and Ray Frank Bessette, Aircraft Carrier Force Levels, Congressional Research Service (1978), p. 7. On possible allocation of a 16-carrier force, see Charles Corddry, "Battle of Congressional Sea Not Over for Big Navy Backers," The Baltimore Sun (October 23, 1978), p. 6.

Both of these requirements are derived from two groups of assumptions that the Navy makes about the importance of its wartime and peacetime missions to U.S. strategy and about the need for carriers to conduct those missions. In terms of wartime planning, the Navy assumes that:

- o A war with the Soviet Union could be worldwide, nonnuclear, and of extended duration.
- o As a consequence, it would be necessary to resupply forward-deployed forces and allies overseas.
- o As a further consequence, it would be necessary to protect the sea-lanes to ensure the success of resupply efforts.
- o Offensive and defensive operations would be necessary for protection to succeed.
- o Aircraft carriers would be critical for such operations.
- o Lesser contingencies, even if they involve the Soviet Union, would not demand as great a level of naval force as a worldwide conflict.

With respect to peacetime presence, the Navy assumes that:

- o Political effectiveness can be measured in terms of overseas deployments; temporary presence would be less effective than permanent deployment.
- o Aircraft carriers are the most effective units for naval political/military operations and are essential to the success of the presence mission.

These assumptions underlie the Navy's distribution of wartime and peacetime missions to different theaters and its sizing of total force requirements on the basis of this distribution.

Distributing Naval Missions Worldwide: Carrier Task Group Operations in Wartime and Peacetime

Naval planners link peacetime forward deployments to the wartime missions and point to four major operating areas for the

carrier force in both peacetime and wartime: the Pacific Ocean, the Atlantic Ocean, the Mediterranean Sea, and the Indian Ocean.

Pacific Ocean Operations. The Navy sees two major missions for its carrier force in wartime and one in peacetime in the Pacific Ocean area. The wartime missions in a worldwide conflict would be protection of the sea-lanes to Japan and possible sea-based strikes against Soviet bases in Asia. 22/ The peacetime mission is one of reassuring allies and neutral countries of U.S. commitments to treaty obligations and to regional stability.

In peacetime, two carriers remain permanently forward deployed in the western Pacific as part of the Seventh Fleet. One operates in the northwest Pacific, specifically to reassure Japanese and South Korean allies, and the People's Republic of China, of U.S. determination to deter and ward off a Soviet attack in the region. The second carrier operates in the southwest Pacific to indicate U.S. interest in the stability of that region.

The two forward-deployed Pacific carriers are supported by carrier forces from the Third Fleet, which is based on the West Coast of the United States. The four Third Fleet carriers include one in overhaul and three undergoing other shipyard repair or participating in training operations. The Navy contends that a six-carrier force is required to permit the permanent deployment of two Seventh Fleet carriers while providing for regular maintenance and overhauls and for sufficient crew training and leave periods.

In a worldwide war, forward-deployed Seventh Fleet carriers could be redeployed from their peacetime stations to carry out any of three missions. Their interceptor aircraft could provide air defense cover for convoys to Japan. This "umbrella" protection would be required along the South China Sea portion of convoy routes to Japan, which is within the range of the Soviet long-distance Backfire bombers but beyond the range of U.S. air defense forces based in Japan (see Figure 1). 23/ The forward

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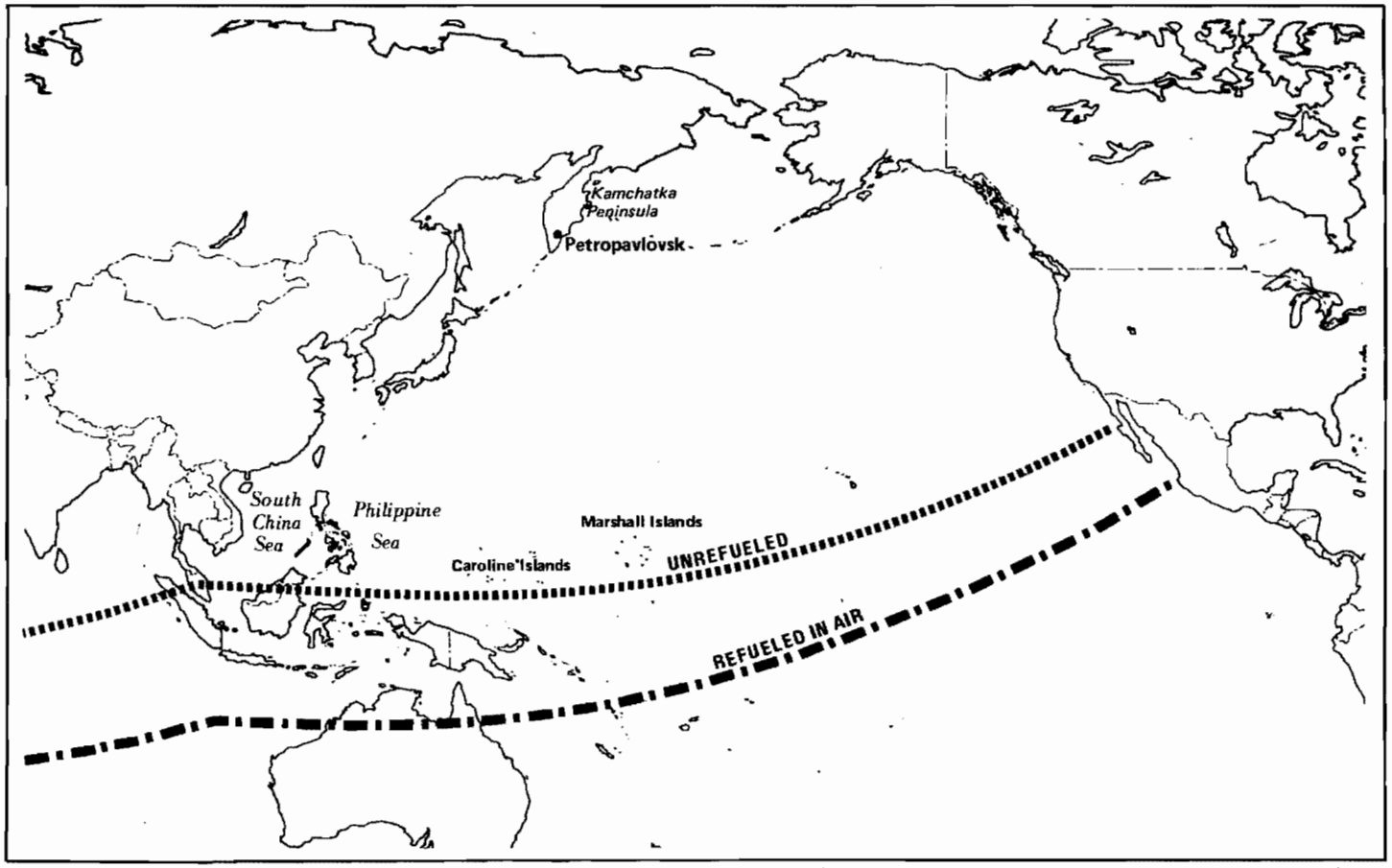
22/ Sea Plan 2000, Executive Summary, pp. 6, 16.

23/ Convoys across the Pacific could transit well to the south of the Caroline and Gilbert Islands and thereby operate beyond unrefueled Backfire radius in the central Pacific. Even if Backfire were refueled, convoys could be routed still further south, through the Tasman Sea and around Australia.

Figure 1.

Soviet Backfire Operating Radius: The Pacific Region

(High-altitude, Anti-shipping Mission Profile)



SOURCE: Department of Defense, *Annual Report, Fiscal Year 1979,* p. 165.

carriers might also be redeployed as part of a larger carrier force--which would include carriers of the Third Fleet from the West Coast--to attack the Soviet mainland. Finally, forward carriers or, more likely, their supporting units on the West Coast could be redeployed to the Atlantic in the event of a worldwide war.

Some observers argue that the capability to attack Soviet Asia is important for several reasons:

- It would serve to deter Japan and China from seeking an accommodation with the Soviet Union in the event of war.
- It would "tie down" certain Soviet assets in Asia in anticipation of a sea-based attack.
- Lastly, if such an attack were undertaken, it would reduce the Soviet Union's ability to cut the sea-lanes to Japan by damaging or destroying submarines and aircraft that were in port as well as necessary support facilities for those systems.

Atlantic Ocean Operations. The Navy attaches primary importance to three key wartime roles for carrier forces in the Atlantic. The first would be to assist in protection of the sea-lanes to Europe. This role would call primarily for air defense, antisubmarine, and possibly antiship operations to protect transiting convoys. The second mission would involve attacks from carriers operating in the north Norwegian and Barents Seas on Soviet air, ship, and submarine bases in the Kola Peninsula (see Figure 2). 24/ As with possible attacks on Siberian bases, the Navy views this "offensive sea control" mission as enhancing the U.S. ability to keep the sea-lanes open to its allies. The third possible mission similarly is one of offensive sea control; it calls for carrier operations in the Norwegian Sea to support U.S. Marine landings in northern Norway. The ability

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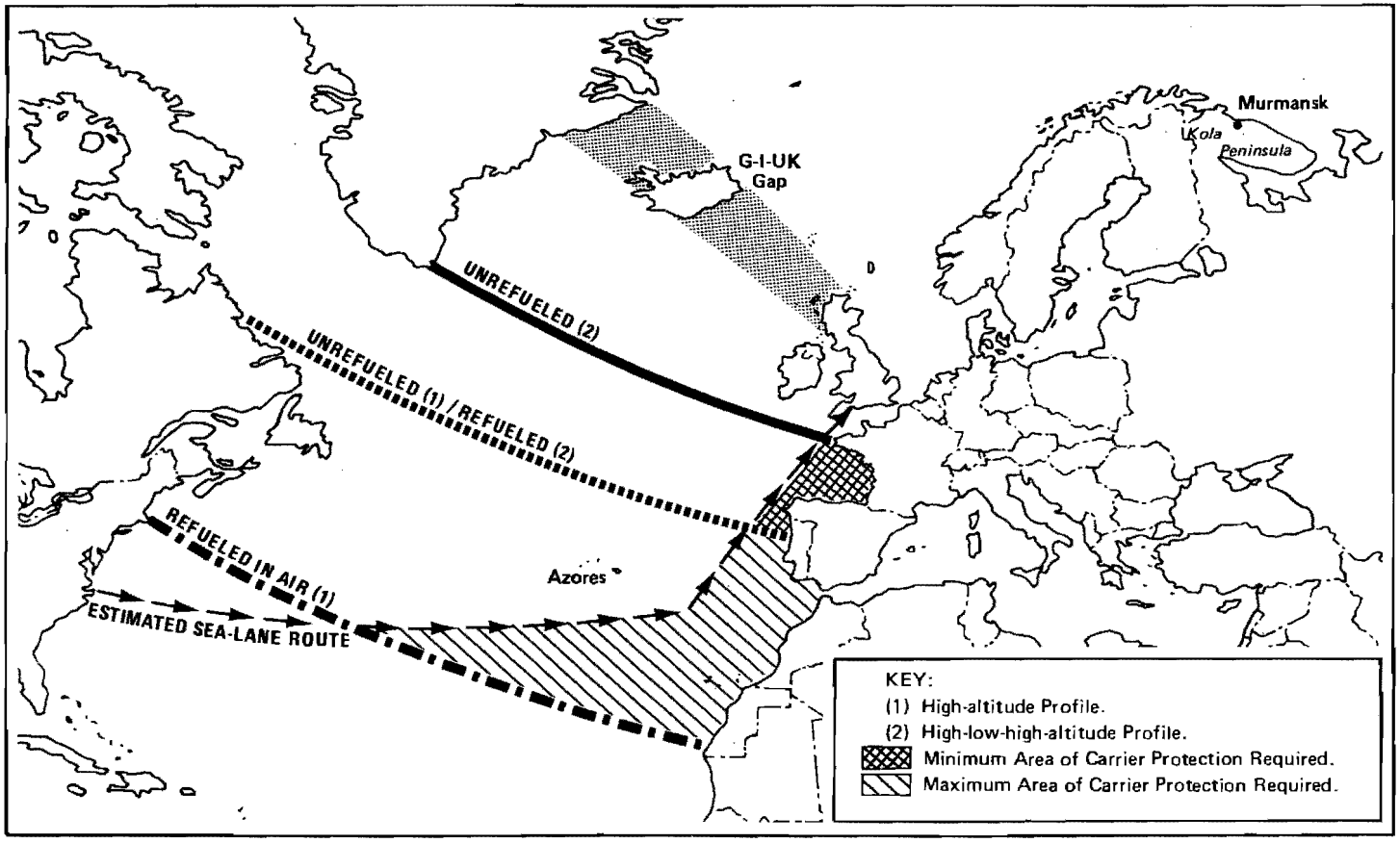
24/ See testimony of Admiral Thomas B. Hayward, Chief of Naval Operations, on "The Fiscal Year 1980 Military Posture and Fiscal Year 1980 Budget of the United States Navy," before the House Committee on Armed Services (February 2, 1979; processed), pp. 17-19; see also Sea Plan 2000, Executive Summary, p. 16.

Figure 2.

Soviet Backfire Operating Radius: The North Atlantic Region

(Anti-shipping Mission Profile)



SOURCES: High-altitude Profile: Department of Defense, *Annual Report, Fiscal Year 1979*, p. 165.

High-low-high-altitude Profile: Derived from Bill Sweetman, "Backfire — The Bogeyman Bomber," *Flight International* (December 17, 1977), by matching flight profiles on page 1814 with map on page 1815.

Estimated Sea-Lane Route: North Atlantic Assembly, *Draft Report on the Activities of the Joint Sub-Committee on the Northern Region*, Appendix (November 1978), p. 2.

to defend this "northern flank" is considered to be important for the cohesion of the NATO alliance, as well as for blocking Soviet air and sea access to the Atlantic Ocean. 25/

The Navy does not forward deploy carriers to the Norwegian Sea in peacetime. Elements of the Second Fleet, stationed on the East Coast of the United States, deploy at irregular intervals to the Norwegian, North, and Baltic Seas, usually as part of joint NATO exercises. Second Fleet carriers, possibly supported by Third Fleet units from the Pacific, would undertake the Navy's wartime tasks in the north Atlantic.

Mediterranean Sea Operations. The Navy views the carrier's role in the Mediterranean as primarily one of power projection, both in the case of a major worldwide war and in local contingencies. Carriers could be used to attack Soviet ports and aviation bases in the Crimea. Such operations would support protection of the sea-lanes to Greece and Turkey. Carriers could also support Marine landings in either country. Lastly, carriers might be used to attack Third World facilities in the event of a minor conflict.

The Navy permanently stations two carriers in the Mediterranean as part of the Sixth Fleet in order to underscore its commitment to its southern NATO allies. The carriers also seek to emphasize the U.S. commitment to regional stability and its support for other friendly states, including Israel, Egypt, and Jordan. The Sixth Fleet operates in close proximity to a large Soviet Mediterranean squadron consisting of surface ships, armed with surface-to-surface missiles, that are often cruise missile units. The Navy argues that the presence of this squadron underscores the need for a permanent U.S. presence in the area. It also states that the Sixth Fleet is vulnerable to an attack that could damage part of its carrier force. 26/ As a result, it appears likely that part of the Second Fleet carrier force would

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25/ See comments of Professor F.J. West in Department of Defense Authorization for Appropriations for Fiscal Year 1979, Hearings before the Senate Committee on Armed Services, 95:2 (March and April 1978), Part 5, p. 4193.

26/ See Admiral Holloway's comments in Department of Defense Appropriations for 1977, Hearings before the Subcommittee on Defense, House Committee on Appropriations, 94:2 (1976), Part 8, p. 184.

have to deploy to the Mediterranean to augment the Sixth Fleet units if the Navy wished to carry out all of its stated missions in that region in a worldwide war or even in a more limited contingency.

During peacetime, Second Fleet carriers support the permanent deployment of the Sixth Fleet units in a manner that corresponds to the relationship between Seventh and Third Fleet carrier forces in the Pacific. The Navy contends that a total of six carriers is required to support the permanent deployment of two Sixth Fleet units in the Mediterranean.

Indian Ocean/Persian Gulf Operations. The Navy has not formally specified the details of its missions in the Indian Ocean and Persian Gulf beyond stating a general need to protect the oil routes from the Persian Gulf to Europe. The Navy currently deploys a single carrier from its Pacific Seventh Fleet to the Indian Ocean for four months each year. Its permanent Persian Gulf presence consists of a flagship and two destroyers. In the event of either a limited contingency or a requirement for Indian Ocean operations in a worldwide war, carriers would have to be deployed from either the Seventh or Third Fleets.

Establishing the Navy's Carrier Force Requirement

In peacetime, the Navy requires twelve carriers, six each in the Atlantic and Pacific, to support the permanent forward deployment of two Sixth Fleet carriers in the Mediterranean and two Seventh Fleet carriers in the western Pacific. The Navy's apparent worldwide distribution of wartime naval missions coincides with its peacetime requirement for 12 operational carriers in the following manner:

- Two carriers, one each from the Pacific and Atlantic fleets, would be in long-term overhaul, leaving 10 for combat. 27/

27/ Statement of Admiral J.L. Holloway, Military Posture and H.R. 10929, Hearings, Part 1, p. 664. Depending on the tempo of scheduled overhauls, one of the two overhauled carriers might be available to the fleet within a month of the outbreak of conflict. Derived from information provided to CBO by the U.S. Navy, September 13, 1978.

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- Two carriers in the Atlantic and two in the Pacific would conduct sea-lane protection operations in order to provide convoys with uninterrupted combat air patrol and early warning protection against attacking aviation and to contribute to the ASW effort.

- At least one additional carrier would likely deploy to the Mediterranean in support of the two carriers that are permanently on station there as part of the Sixth Fleet. (This was the case during the October 1973 war.)

The remaining three carriers could be assigned to any of the other missions outlined in preceding sections. One carrier might deploy to the Mediterranean to support operations in Greece or Turkey. All three might combine with part of the Atlantic sea-lane forces to support operations against the Kola Peninsula, to support Marine landings in Norway, or to provide additional air defense capabilities near the Greenland-Iceland-United Kingdom (G-I-UK) "gap" through which attacking Soviet air forces might deploy. Again, the three carriers might combine with a portion of the Pacific sea-lane protection force to support operations against Soviet Asia.

While the Navy does not rule out any of these missions, it has emphasized the last of the three in its recent major naval force planning study, Sea Plan 2000. 28/ The study implies that, were the Navy to assign at least two carriers to the Pacific "offensive sea control mission," it could maintain the option of "opening a second front" with the Soviet Union and, as noted above, prevent a major transfer of Soviet units to its western front. 29/

In emphasizing the importance of Pacific carrier operations against Soviet Asia in wartime, the Navy underscores the current

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28/ Sea Plan 2000, Executive Summary, pp. 15-16; see also testimony of Professor F.J. West, in Military Posture and H.R. 10929, Hearings, Part 4, p. 987.

29/ Sea Plan 2000, Executive Summary, p. 20. It is noteworthy that the Navy does not discuss which Soviet units would be prevented from transferring to the European theater as a result of a "second front" attack.

distribution of carriers in peacetime. Six Pacific operational carriers (including one unit in overhaul) could undertake the attack mission against the Soviet Union, and six in the Atlantic could support remaining sea control operations. Nevertheless, assigning carriers to the wartime offensive mission would represent a change from prior official statements of Navy strategy. As recent Navy testimony has indicated, that strategy emphasizes the option of transferring carrier forces that are part of the peacetime Pacific fleet to the Atlantic for wartime operations. 30/

The Navy's wartime requirement for 12 carriers thus coincides with the peacetime need for a 12-unit force to support four permanent overseas carrier deployments. It also provides a hedge against the demands of lesser contingencies that might involve Soviet forces. The convergence of the Navy's requirements has added strength to the request for an additional carrier to preserve a 12-carrier force level for the foreseeable future.

DoD CARRIER REQUIREMENTS: SIMILAR FORCE LEVELS BUT A DIFFERENT RATIONALE

The Department of Defense consistently has supported the Navy's requirement for 12 active, deployable carriers. Its rationale currently appears to vary somewhat from that which the Navy offers, however. The DoD posture statement for fiscal year 1980 points to the need for carrier operations on the flanks of NATO and in lesser contingencies, but offers no hint as to what force level is required for such operations. Indeed, the report stresses the benefits of a defensive posture for sea-lane protection that exploits the geographic barriers to Soviet operations in the open ocean, and merely "does not preclude" 31/ forward operations that might be termed "offensive." On the other hand, the report is quite specific about the rationale for requesting a twelfth carrier: "Twelve active, deployable carriers are sufficient to maintain our current posture of stationing two

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30/ Testimony of Admiral J.L. Holloway, in Military Posture and H.R. 10929, Hearings, Part 4, pp. 637-38; see also testimony of Professor F.J. West, in Military Posture and H.R. 10929, Part 4, p. 987.

31/ U.S. Department of Defense, Annual Report, Fiscal Year 1980, p. 108.

carriers in the Mediterranean and two in the Western Pacific theater." 32/ Thus, it appears that peacetime, rather than wartime, requirements are the prime determinant of the DoD, as opposed to Navy, requirements for a 12-carrier force.

RECAPITULATION: THE PLACE OF THE CARRIER AND ITS AIR WING IN NAVAL CONVENTIONAL WARFARE OPERATIONS

Aircraft carriers and their air wings dominate the planning of both peacetime and wartime naval operations. A large portion of the remainder of the Navy general purpose forces is geared to supporting carrier operations. The 12-carrier force is meant to conduct a variety of missions, in four major locales, with appropriately organized air wings. While carriers have considerable capabilities that could be applied to the missions that the Navy assigns to them, there remain a number of questions both about the missions themselves and about the suitability of carriers for those missions relative to other systems that are, or might be, available for maritime operations. These questions affect not only choices about whether to procure additional carriers, but also decisions about what aircraft should be procured for the carriers that are currently in the fleet and will operate for at least the next two decades. The following chapter reexamines the relationship of the Navy's missions both to the national strategy and to requirements for carrier forces. It outlines alternative ways to carry out U.S. maritime objectives in peace and war. Chapter IV then examines the specific application of particular aircraft types to the Navy's missions in light of the consideration that, while the carrier will remain a major element of the Navy's force mix for the remainder of this century, other systems might carry out some missions that are now the exclusive domain of carrier forces.

32/ Ibid., p. 162.

CHAPTER III. REEXAMINING CARRIER FORCE REQUIREMENTS

Chapter II indicated that two sets of assumptions govern the Navy's requirements for carriers. One set of assumptions governs wartime requirements; the other, peacetime needs. The chapter also indicated that the Department of Defense appears to require 12 carriers primarily to meet peacetime political needs. With respect to wartime operations, it is, of course, impossible to forecast the nature or duration of a third world war. Naval forces represent a hedge against the possibility that such a war would be fought with conventional weapons for an extended period. These forces would protect reinforcements and materiel sent overseas to sustain the long-term operation of forward units. A series of offensive operations might not, however, be critical to the Navy's goal of keeping the sea-lanes open for resupply. Furthermore, the currently planned number of aircraft carriers might not be necessary to ensure successful completion of the sea control mission.

Carrier requirements cannot be formulated solely on the basis of expected contingencies, since carriers are flexible instruments of warfare that are particularly well suited to unforeseen demands in wartime. Nevertheless, even an 11-carrier force--one that does not require procurement of an additional carrier--might furnish that flexibility by providing for more than the strict demands of defensive sea control operations. It could thus embody a hedge against demands for carrier forces that cannot be anticipated before they materialize. The question before the Congress with respect to wartime demands for additional carrier forces thus is not merely "how much is enough for foreseen missions," but also "how much <u>of a hedge</u> is enough against unforeseen missions."

Similar reservations apply to stated requirements for peacetime operations, which the Navy views as residual but which DoD uses to justify its 12-carrier force requirement. Presence can be politically effective even if it is maintained on an intermittent basis. Indeed, ships less capable than carriers might credibly convey the sincerity of U.S. commitments to allies and to preserving regional stability in areas in which local

forces cannot mount a major threat to the U.S. fleet. The use of large-deck carriers in these regions might, therefore, be an inefficient means of achieving U.S. peacetime objectives.

This chapter treats each of these considerations in turn and outlines alternate ways of meeting U.S. maritime mission requirements. It devotes primary attention to wartime missions; peacetime missions and postures are discussed at length in a supporting CBO background paper and are only summarized here. 1/

REEVALUATING THE NAVY'S WARTIME ASSUMPTIONS AND CARRIER FORCE NEEDS

The Atlantic Theater

Of the four geographic areas in which the Navy anticipates wartime operations, the Atlantic Ocean and its sea-lanes could be the most critical in a war with the Warsaw Pact that centered in Europe. In addition to providing support for Marine landings in northern Norway, offensive sea control operations in the Atlantic theater could include attacks on Soviet bomber and submarine bases in the Kola Peninsula. The Navy considers that such attacks would contribute to allied anti-air warfare (AAW) and antisubmarine warfare (ASW) operations in defense of the sea-lanes to Europe.

Difficulty of Offensive Operations Against Soviet Bases. The fighter and attack aircraft aboard large-deck carriers would be the key offensive units in Navy operations against the Kola Peninsula. As a consequence, carriers would be the prime targets for Soviet antiship systems. Table 1 indicates a portion of the threat that would confront carriers conducting offensive sea control. The Soviet Union has sufficient antiship missile launchers in its Northern Fleet inventory to target as many as six carriers with more than 100 missiles each. Even if not all the launchers were available, the Northern Fleet would still pose a formidable missile threat to carrier task groups. Indeed, the antiship missile threat could

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1/ Congressional Budget Office, U.S. Naval Forces: The Peacetime Presence Mission, Background Paper (December 1978).

TABLE 1. SOVIET ANTISHIP MISSILE LAUNCHERS IN THE NORTHERN FLEET, 1977-1978

System	Units	Launchers per Unit	Total Launchers
Aircraft			
Tu-16 (Badger)	85	2 a/	170 a/
Tu-26 (Backfire)	10	1	10
Subtotal	95		180
Submarines			
Papa	2	10	20
Charlie II	3	8	24
Charlie I	7	8	56
Echo II	15	8	120
Juliet	12	4	48
Whiskey	2	4	8
Subtotal	41		276
Surface Ships/ Missile Boats			
Kiev	1	8	8
Kresta I	2	4	8
Kynda	-	-	-
Kashin	1	4	4
Nanuchka	4	6	24
Osa	31	4	124
Subtotal	39		168
Total Launchers			624

SOURCES: Derived from Jane's Fighting Ships, 1978-79; Robert P. Berman, Soviet Air Power in Transition (Washington, D.C.: The Brookings Institution, 1978), p. 43; Robert P. Berman, "Soviet Naval Strength and Deployment," in Michael MccGwire and John McDonnell, eds., Soviet Naval Influence: Domestic and Foreign Dimensions (New York: Praeger, 1977), pp. 324-26; and Barry C. Wheeler and Bill Sweetman, "Military Aircraft of the World," Flight International (March 4, 1978).

a/ Some Badgers (Badger "C") carry only one missile; few of these, however, remain in the Soviet Naval Aviation force.

be supplemented by more than 90 torpedo submarines, bombers from the Long Range Aviation force, and elements of the 300-plane 13th Air Army in the Leningrad Military District. 2/

In contrast, only carrier task force resources--primarily the fighter, attack, ASW, and support aircraft aboard each carrier, as well as the AAW and ASW systems aboard carrier escorts--would provide for the carrier's defense. While these systems might suffice to protect a part of the carrier force, the mass of Soviet antiship systems renders it doubtful that sufficient carriers would survive to carry out all the attacks that the task force had been assigned.

Possibility of Defensive AAW Operations. A defensive AAW and ASW posture would likely place fewer demands on carrier force levels and on highly capable interceptor and attack aircraft forces. It would provide solely for the defense of convoys, which are the primary object of naval protection. With respect to anti-air protection, if convoys were routed well south of the Azores, they could be reached only by Backfires, and then only when they headed north past the Azores to Western Europe (see Figure 2 on p. 21) 3/ Only a limited number of Backfires would be available for the Atlantic antiship mission, however. The force of 450 Backfires postulated for the 1990s 4/ is likely to be divided approximately evenly between SNA and LRA, and SNA would further subdivide its Backfires among the Northern, Pacific, and Black Sea fleets.

2/ See Jane's Fighting Ships, 1978-79; and Robert P. Berman, Soviet Air Power in Transition (Washington, D.C.: The Brookings Institution, 1978), pp. 41, 44.

3/ A convoy route that passed south of the Azores to avoid Backfires would, of course, result in a longer transit for U.S. ships to Europe. At an average convoy speed of 16 knots, each additional 384 nautical miles of the route would add one day to the transit time.

4/ If Backfires continue to be produced at the current rate of 30 each year, the force will not reach 450 aircraft until 1989, 15 years after its introduction into SNA and LRA.

An SNA Backfire raid, or even one augmented with LRA Backfires, would have to penetrate a series of air defense obstacles akin to a gauntlet system that would force the Backfires to fly altered profiles, including either low-level flights (a "hi-lo-hi" profile) or supersonic dashes, or both. Such profiles would seriously reduce their range 5/ and would also result in multiple rounds of losses both before and after they approached the convoys or, alternately, the carrier forces. 6/

5/ For an illustration of the effects of supersonic dash and low flight profile missions on Backfire range, see Bill Sweetman, "Backfire - The Bogeyman Bomber," Flight International (December 1977), pp. 1814, 1815. Backfires seeking to attack sea-lanes would have to fly either low-profile or "dash" missions over Iceland (both to and from the sea-lanes) as well as similarly taxing profiles when they approached the area covered by carrier-based combat air patrol.

6/ The first stage of the gauntlet facing the Soviets would consist of U.S. and U.K. interceptors operating from bases along the G-I-UK gap that lies athwart Soviet air and sea routes to the Atlantic. Bombers that survived the land-based interceptors would then have to contend with defenses positioned closer to convoys. As few as two carriers would permit around-the-clock early warning coverage of likely Backfire routes. Their F-14s would then exert a second round of attrition against oncoming bombers. The remaining attackers would have to contend with the area air defenses of the convoy or carrier escorts, depending on which were the targets of their attack. If carriers were their targets, they would face the rapid-response, multiple track-target-and-kill capability of the AEGIS area air defense system and would also have to contend with close-in defenses. And the reduced Backfire force would have to face the land-based interceptors on its return flight to base. Backfire losses would deplete a force that could also be used by the Soviets for strategic missions (at least against Western Europe) as well as against naval forces that the Soviets might fear would approach their homeland. The prospect of such losses may indeed deter a Backfire attack against sea-lanes at great distances from Soviet territory.

It might be argued that additional carriers--beyond the two assigned to provide the convoy's air defense umbrella--are needed to enhance the defensive AAW effort. Recent studies by CBO and others have demonstrated, however, that for the Atlantic theater it is less costly to base AAW elements of an additional carrier air wing on land and improve current land-based assets than it is to procure a carrier on which to deploy them. 7/ Indeed, the Department of Defense already has enhanced allied early warning capability in Iceland with land-based units. Two airborne warning and control (AWACS) aircraft, deployed to Iceland in October 1978, 8/ represent a significant improvement over the EC-121 early warning aircraft previously stationed there. Earlier warning and air control will enable more interceptors to respond to incoming Backfire threats. Thus, given two carriers operating in the Atlantic sea-lanes to defend convoys, additional carriers would not be the most cost-effective means of enhancing U.S. air defenses for sea control.

ASW Operations: An Offensive or Defensive Mission Requirement? Offensive sea control in the Atlantic, which requires large carrier forces, also might not be necessary for successful ASW operations. Given massed anticarrier defenses near the Soviet homeland, strikes against Soviet submarine bases could be costly in terms of potential carrier losses. On the other hand, if a large number of Soviet submarines was deployed to battle stations

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7/ See Deborah Shapley, "New Study of Land-Based Aircraft Questions Need for Aircraft Carriers," Science (June 2, 1978), pp. 1024-25; remarks of Representative Patricia Schroeder, Congressional Record (August 7, 1978), p. H8013; Congressional Budget Office, The U.S. Sea Control Mission: Forces, Capabilities, and Requirements, Background Paper (June 1977), pp. 30-34.

8/ Information provided to CBO by the U.S. Air Force, January 17, 1979. See also "Air Force 'Sentry' Radar Plane to be Stationed in Japan," Los Angeles Times (January 20, 1979). The addition of AWACS to the Iceland air defense forces reduces the marginal costs required to provide an air defense capability equivalent to that which an additional carrier air wing would provide, and thereby increases the marginal cost-effectiveness advantage of the land-based option.

before a war's outset, an attack against their bases might be of little value. The submarines, especially nuclear-powered units, could return to other ports--even Petropavlovsk in the Pacific--for resupply. Further, even if they remained in port, they would be highly vulnerable to the U.S. antisubmarine gauntlet in the Atlantic once they emerged. This gauntlet would consist of nuclear-powered submarines, mines, submarine surveillance systems (SOSUS), patrol aircraft, open ocean search submarines, and convoy escorts and escort-based helicopters, as well as ASW patrols by S-3 and SH-3 aircraft from the two carriers providing the convoy air defense "umbrella."

Thus, it is not at all clear why Soviet submarine bases would have to be hit by planes from large-deck carriers if U.S. forces were conducting the ASW mission in order to ensure the resupply of Europe. To the extent that Soviet forces left their bases, they would be met by U.S. defensive units. If they did not depart from their bases, the U.S. resupply objective would be met. It is somewhat problematical to argue that U.S. forces should take additional risks to achieve an end that can be realized by less demanding means. Lastly, bases could be hit by systems other than carrier-based aircraft (for example, missiles and long-range, land-based aircraft such as Air Force F-111s and B-52s) if a war in which superpower territories were attacked remained conventional.

As is the case with defensive AAW, additional carriers--beyond the two already allocated to convoy protection--might not be the most cost-effective approach to enhance defenses against submarines. The carrier's contribution to that effort would come at the margin of a long chain of probabilistic encounters between enemy submarines and U.S. nuclear-powered attack submarines, mines, land-based antisubmarine aircraft, and ASW helicopters from surface escorts, as well as ASW systems aboard those escorts. Of these encounters, the most critical would be those with submarines and mine barriers in regions remote from the convoys and those with surface escort systems and helicopters in the convoy's immediate vicinity. Mine barriers would likely result in high levels of enemy attrition, because they could be placed across key Soviet sea routes to the Atlantic. Because of geographic constraints, enemy submarines would have to encounter them either when exiting from or returning to base. Similarly, it would be difficult for Soviet submarines seeking to attack convoys to avoid the surface escorts accompanying

the convoy units. Planned improvements in shipboard sonar--particularly the introduction of tactical towed array sonar and the LAMPS III ASW helicopter in the early 1980s--would enable surface units to respond rapidly to long-range sonar contacts. (The LAMPS III has a 100-nautical mile radius of action, beyond the range of Soviet antiship missiles that do not require mid-course guidance.) 9/

In contrast, enemy submarines could avoid areas where U.S. carrier forces would likely conduct open ocean searches. Without information obtained from sources apart from the search process, those searches--conducted by means of monitoring sonobuoys dropped from patrol aircraft--would be virtually random. As a result, the probability of encountering and detecting enemy submarines, and of destroying them, would be lower than corresponding probabilities associated with barrier and convoy escort operations.

Given the greater uncertainties of detection that attend carrier ASW (particularly if, for some reason, external information is unavailable to support S-3 operations) as opposed to those of other ASW systems, and given, too, the greater cost of carrier forces relative to these other systems, it would appear difficult to make a case for an additional carrier on ASW grounds. In this regard, it is noteworthy that the Department of Defense phased out the antisubmarine carrier (CVS) force in the early 1970s precisely because of such cost-effectiveness considerations. 10/

The Pacific Theater

Many of the observations regarding the demand for carriers in the Atlantic do not lend themselves easily to the Pacific

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9/ See Dan Manningham, "LAMPS III," United States Naval Institute Proceedings (March 1978), p. 159. Soviet long-range antiship missiles require guidance from Bear aircraft. These aircraft would be vulnerable to the carrier AAW umbrella, however. See Jane's All The World's Aircraft, 1978-79.

10/ U.S. Department of Defense, Annual Report, Fiscal Year 1968, p. 86.

theater. There is nothing in the Pacific comparable to the G-I-UK gap through which all Soviet units must pass. To be sure, a major part of the Soviet fleet is located at Vladivostok, on the Sea of Japan, whose straits could be closed to Soviet shipping by mines and submarine patrols. Nevertheless, no such obstacle confronts the Soviet units that would exit from Petropavlovsk, on the Kamchatka Peninsula (see Figure 1 on p. 19). Similarly, Soviet aviation units could be routed over Kamchatka and through the central Pacific to avoid U.S. and Japanese interceptors operating from Japan.

The Soviet fleet's access to the open ocean prompts the U.S. Navy to consider the option of undertaking offensive sea control operations in the Pacific. As noted above, there are other reasons for considering this option, notably the ability to open a "second front" in the Pacific, thereby tying down Soviet units that might otherwise be transferred to the Soviets' western front.

Offensive sea control in the Pacific would demand a large number of large-deck carriers, though perhaps not as many as might be required in the Atlantic for offensive purposes. Table 2 indicates that the Soviet Union has more than 500 anti-ship missile launchers in East Asia, enough to target as many as five carriers with 100 missiles each. Nevertheless, this figure is lower than the corresponding number in the Northern Fleet and becomes significantly lower if only the most modern ship and submarine launchers are considered. In addition, the Soviet Pacific fleet numbers only 49 torpedo submarines, just over half the Northern Fleet complement. Finally, the remoteness of the Kamchatka Peninsula, even from eastern Siberia, makes reinforcement far more difficult for the Soviet Union in that region than it is in the Kola area. 11/ Still another complicating factor for the Soviet Union is China, against which much of Soviet Frontal Aviation in East Asia is directed. 12/

11/ See Colonel William V. Kennedy, USAR, "Kamchatka: Non-Nuclear Deterrent," Military Review (August 1978), pp. 16-17.

12/ Barry M. Blechman, et. al., The Soviet Military Buildup and U.S. Defense Spending (Washington, D.C.: The Brookings Institution, 1977), p. 40.

TABLE 2. SOVIET ANTISHIP MISSILE LAUNCHERS IN THE PACIFIC FLEET, 1977-1978

System	Units	Launchers per Unit	Total Launchers
Aircraft			
Tu-16 (Badger)	85	2 a/	170 a/
Tu-26 (Backfire)	-	-	-
Subtotal	85		170
Submarines			
Papa	-	-	-
Charlie II	-	-	-
Charlie I	5	8	40
Echo II	14	8	112
Juliet	4	4	16
Whiskey	2	4	8
Subtotal	25		176
Surface Ships/ Missile Boats			
Kiev	-	-	-
Kresta I	1	4	4
Kynda	2	8	16
Kashin	4	4	16
Nanuchka	-	-	-
Osa	35	4	140
Subtotal	42		176
Total Launchers			522

SOURCES: Derived from Jane's Fighting Ships, 1978-79; Robert P. Berman, Soviet Air Power in Transition (Washington, D.C.: The Brookings Institution, 1978), p. 43; Robert P. Berman, "Soviet Naval Strength and Deployment," in Michael MccGwire and John McDonnell, eds., Soviet Naval Influence: Domestic and Foreign Dimensions (New York: Praeger, 1977), pp. 324-26; and Barry C. Wheeler and Bill Sweetman, "Military Aircraft of the World," Flight International (March 4, 1978).

a/ Some Badgers (Badger "C") carry only one missile; few of these, however, remain in the Soviet Naval Aviation force.

No such obstacle confronts the 300-unit Frontal Aviation force in the Leningrad Military District, whose most modern fighter/attack units could reach a U.S. carrier task force operating in the Barents Sea.

Objections can nevertheless be lodged against both the offensive sea control mission itself and the demands it might impose on the large-deck carrier force. Any attack on the Soviet homeland would increase the risk that the Soviet Union would respond with nuclear weapons. This possibility would be reinforced by the fact that Petropavlovsk in particular is a base for Soviet ballistic missile submarines (SSBNs). 13/ If the Soviets viewed an attack on their SSBN base as an attempt to reduce their nuclear deterrent, they could choose to respond in kind.

In addition, there remains the question of the value of attacks on East Asian bases in a conventional conflict, particularly with regard to anti-air warfare. As with Atlantic operations, if convoys were routed far enough south in the Pacific, they could transit to Japan beyond the range of all Soviet aircraft except for the Backfire. Indeed, if they steamed south of the Marshall and Caroline Islands, they would be beyond unrefueled Backfire range until they reached the Philippine Sea (see Figure 1 on p. 19). 14/ At this stage, however, Backfires would encounter land-based interceptors from Japan, Okinawa, and the Philippines. Thus, given the availability of land-based interceptors to counter threats to convoys transiting the Philippine Sea, defensive sea control in the Pacific might require as few as two carriers, which would provide umbrella protection for convoys against Backfires that survived attacks from land-based aircraft.

It might nevertheless be argued that, if Backfires were refueled en route to the sea-lanes, they could avoid land-based air defenses entirely and reach considerably south of the Marshalls and Carolines. Furthermore, it could be argued that the sufficiency of projected land-based aviation assets is sensitive

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13/ Norman Polmar, "The Soviet SLBM Force," Air Force Magazine (March 1978), p. 45.

14/ U.S. Department of Defense, Annual Report, Fiscal Year 1979, map, pp. 165.

to the expected level of the bomber threat and its probable flight path. Should Soviet forces be transferred to the Pacific from other SNA units, or from the LRA force, interceptor assets protecting the convoy might have to be increased. On the margin, however, land-based assets might not be as cost-effective as carrier forces. Carrier aircraft could be concentrated near convoys and, therefore, have a high assurance of encountering Backfires, while land-based units would have to be spread among several western Pacific bases to cover all Backfire flight paths. A larger number of these units would be required to achieve the same number of expected encounters as a carrier-based force. In this regard, therefore, the Pacific case would not be analogous to that of the northern Atlantic, where the G-I-UK gap lies astride all Backfire flight paths to the mid-Atlantic and could be completely covered by U.S. forces in Iceland coupled with British forces deploying from the United Kingdom.

If defensive sea control is judged to be more demanding in the Pacific, it might be assumed that offensive sea control strikes against Petropavlovsk would be necessary and desirable. It is not clear, however, that carriers need carry out this mission alone. A carrier strike could be considerably supplemented by land-based aircraft. The 12 Marine A-6 aircraft operating from Japan have sufficient range to reach Petropavlovsk if refueled by KC-130 tankers; so, too, do the 12 Air Force B-52Ds operating from Guam. 15/ The A-6s could attack at low altitudes and would not require fighter escorts. The B-52s would need escorts, but these could be flown from carriers. 16/ Lastly, cruise missiles, such as the Tomahawk, could considerably augment the firepower of a carrier task force attacking Soviet bases. The Tomahawk, currently under development, is a 350-nautical mile

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15/ Other assets might also be made available. Another 24 Marine A-6s are based in California but could be ferried to Japan well before carriers moved into position to strike Petropavlovsk. Similarly, F-111s based in the United States could be staged forward to operate from Japanese or Alaskan bases.

16/ Of course, joint service exercises must be conducted in peacetime if this kind of combined arms operation is to succeed in wartime.

missile that will be fired from submarines and could also be deployed aboard surface ships, such as the DDG-47. Each missile will have a 1,000-pound, high-explosive warhead and will be precision guided. 17/ Warships carrying these missiles could contain reloads; submarines are likely to have several missile launchers.

The critical question with respect to the use of land-based aircraft for offensive sea control in the Pacific is their availability. If Asian-based B-52s and A-6s were available to augment the operations of the Pacific carriers, they surely could equal the marginal contribution of the 36 to 40 attack aircraft that a single carrier would provide. These planes may be required for other missions, however. In that case, unless the effectiveness of ship- and submarine-launched Tomahawks can be demonstrated to match that of the attack element of carrier air forces, carriers are likely to remain the sole means of launching conventional attacks against Soviet bases on Kamchatka. 18/

In sum, the case for attacks on Soviet bases in the Pacific appears somewhat stronger than it does in the Atlantic if it is felt that the mission would be feasible in a conventional war and would not lead to nuclear conflict. If land-based air forces proved unavailable, carrier forces would be required for this offensive mission. The Navy has stated that a 12-carrier force would provide the minimum level needed to sustain a "second front" operation in addition to other Navy missions. Thus, even if a defensive posture were assumed in the Atlantic, a 12-carrier force would still be required to support the offensive operations that the Navy anticipates in the Pacific theater.

17/ Jane's Weapons Systems, 1978, p. 25. See also Captain William J. Ruhe, USN (Ret.), "Antiship Cruise Missiles," National Defense (November-December 1978), p. 31.

18/ A possible solution may be procurement of updated FB-111s, although their cost--and therefore their cost-effectiveness relative to the carrier--is difficult to estimate in the absence of any firm decision regarding procurement of these systems for the strategic bombing mission.

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The Mediterranean Theater

The most demanding requirements for carrier forces in the Mediterranean are put in terms both of an early "shoot-out," in which Soviet forces launched a preemptive strike against the U.S. fleet, and of the need to support Marine operations in southern Europe. 19/ If carriers were not initially deployed in the eastern Mediterranean, however, they might be less vulnerable to a preemptive Soviet attack. Further, with respect to tactical aviation support for Marine landings or for other overland operations, land-based aircraft could be transferred from southern European bases to undertake the same overland functions in Greece or Turkey that would be demanded of the wing of a fourth carrier in the Mediterranean (beyond the two carriers now deployed there and the third which might be sent). 20/ If still more aircraft were required specifically for the land battle, it would be less costly to procure and base them on land than to procure the aircraft and a carrier on which to base them.

The Indian Ocean Theater

Operations in the Indian Ocean are the least clearly defined of all Navy missions. They might not be crucial early in a war, since the most important sea-lane through the Indian Ocean is the petroleum route to Europe, and European petroleum reserves would ensure that fuel will not be a pressing need in the earliest stages of a war. 21/ If naval forces were required in the Indian

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19/ See testimony of Admiral James L. Holloway, III, in Department of Defense Appropriations for 1977, Hearings before the Subcommittee on Defense, House Committee on Appropriations, 94:2 (1976), pp. 184-85.

20/ For a discussion of the availability of the third carrier, see Chapter II. Land-based tactical aircraft could also play an important role in protecting carrier forces from a bomber attack.

21/ All members of the International Energy Agency, which includes all members of the NATO integrated military command except for Portugal, were said to have had 60 to 70 days of

Ocean later in a war, carriers could probably be diverted from other regions where the demand for their capabilities was no longer pressing.

Recapitulation: A Lower Wartime Demand for Carriers?

The Navy advocates a 12-carrier force level in order to be able to conduct operations against Soviet bases in support of sea control during a major conflict with the Warsaw Pact. The Navy views such operations as particularly useful in the Pacific in order to open a "second front" in a worldwide war. A 12-carrier force would provide sufficient units both for defensive missions worldwide and for a major force to conduct attacks in the Pacific in support of the two-front strategy. 22/ According to the Navy, it would allow for the "minimum acceptable risk" to U.S. military objectives. Thus, if offensive sea control is viewed as a critical Navy mission, adding another large-deck carrier is a necessity, not merely an additional hedge against unspecified requirements.

If defensive operations are emphasized instead of offensive sea control in both the Atlantic and Pacific Oceans, the demand for carriers would drop from twelve to nine--that is, two carriers

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petroleum reserves in 1976, and were expected to have 90 days of reserves by 1980. See interview with J. Wallace Hopkins, Deputy Executive Director, International Energy Agency, in Journal of Commerce (October 15, 1976), p. 3. Recent reestimates indicate that the leading European oil importers and Japan will have six to eight weeks of emergency reserves by 1980, with other domestic supply measures providing an additional buffer. The stocks could provide "substantial protection" beyond the six-week to eight-week period "if countries are willing to restrain their use of oil in an emergency." Edward N. Krapels, "Preparing for an Oil Crisis: Elements and Obstacles in Crisis Management" (discussion paper prepared for Resources for the Future, Inc., January 1978; processed), pp. 1-2, 12, 19.

22/ See U.S. Department of the Navy, Sea Plan 2000, Executive Summary, Unclassified (March 28, 1978), p. 20.

could operate defensively in each ocean, three could operate in the Mediterranean, and two would be in overhaul. Therefore, the current 11-carrier force already provides a hedge against other unforeseen requirements. These could include a demand for carriers as part of a large force attacking Kamchatka or, indeed, the Kola Peninsula; a greater demand for carriers in the Mediterranean; a need for carriers in the Indian Ocean; or additional carriers for defensive sea control. These requirements also could include a lesser contingency, which would not demand carrier force levels equal to those required in a worldwide war. 23/

REEVALUATING THE TWELVE-CARRIER REQUIREMENT FOR PEACETIME OPERATIONS 24/

The Navy's 12-carrier force requirement applies to peacetime as well as to wartime operations. Furthermore, DoD stresses peacetime requirements as the major reason for maintaining a 12-carrier force. 25/ The Navy's forward posture assumes a requirement for permanent presence. It also assumes that aircraft carriers are the most effective instruments for conducting presence operations. As a result, DoD and the Navy have established requirements for four permanent carrier stations in the regions in which carriers have operated since World War II--two stations in the Pacific and two in the Mediterranean. On average, three carriers are required to support each station in order to permit crews to divide their time between home port and overseas tours, and to allow for periods when carriers will undergo extended

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23/ See, for example, the discussion of possible carrier requirements in the Persian Gulf in Congressional Budget Office, U.S. Projection Forces: Requirements, Scenarios, and Options, Budget Issue Paper for Fiscal Year 1979 (April 1978).

24/ This discussion is drawn from Congressional Budget Office, U.S. Naval Forces: The Peacetime Presence Mission, which discusses at greater length issues relating to U.S. maritime peacetime missions.

25/ U.S. Department of Defense, Annual Report, Fiscal Year 1980, p. 162.

maintenance or serve in training exercises. If these assumptions are accepted, a total of 12 operational carriers is required.

Maintaining permanent large-deck carrier stations is not necessarily the most efficient means of employing carrier power, however. The following survey of regional deployments attempts to show that less permanent stations, or less capable ships, might equally well achieve U.S. maritime presence objectives in peacetime. It should be noted that, over a longer period of time, there may be adverse changes in the anticipated threat to U.S. forces, as well as equally unexpected and countervailing changes favorable to the United States. The following discussion addresses missions in terms of what can be anticipated in the near future.

The Northwest Pacific

The United States deploys forces to the northwest Pacific to deter threats against its Japanese and Korean allies and to reassure the People's Republic of China and other states of its determination to promote stability in the region.

Only one carrier is stationed regularly near Northeast Asia. The nature of carrier air wing operations would require two carriers for around-the-clock coverage, however. It might, therefore, be argued that an additional carrier is needed to provide a truly credible deterrent to the powerful naval surface, subsurface, and aviation units that the Soviets have deployed in the area. A second carrier on station hundreds of miles away might not have the desired stabilizing effect, since it would not necessarily be seen as part of the Northeast Asian balance. Additionally, it could not play a significant role in the early phases of a short-warning attack in Northeast Asia, an attack that a number of observers consider to be highly possible in Korea, where North Korea maintains large ground forces near the 22nd Parallel.

The Southwest Pacific

In contrast, carrier deployments in the southwest Pacific/ South China Sea region appear to exceed the requirements for operations that seek to promote regional stability and help control crises from escalating to conflicts. No Southeast

Asian state can credibly threaten large U.S. naval task groups. Nevertheless, the possibility that antiship missiles could penetrate a carrier's defenses cannot be completely eliminated. 26/ The problem of the carrier's political credibility then becomes paramount. If the carrier is not invulnerable, U.S. planners might be reluctant actually to employ its firepower in a situation in which vital U.S. interests were not at stake. Under such conditions, its mere presence might indicate a token reaction by the United States that other states could ignore. Given such circumstances, the value of carrier presence in the Southeast Asian region becomes problematical. What may be required is a less capable, but effective, system around which a task force might be built that could equally well demonstrate day-to-day U.S. interest in the region. The carrier would then be deployed to the region only when its use was deemed likely, and its deployment would indicate as much to all local parties.

The Indian Ocean

Similar observations apply to the Indian Ocean, where a carrier task force deploys on a less regular basis. The level of threat from potentially antagonistic littoral states is relatively low, but the safety of the carrier is not totally assured. Here, too, U.S. concern in a region of acknowledged importance to U.S. interests might be asserted by a less capable, but nevertheless powerful, alternative to the aircraft carrier, representing a slightly lower profile than that of the more capable ship.

The Mediterranean Sea

U.S. Mediterranean deployments involve completely different considerations. There is a significant threat from the Soviet squadron that deploys in close proximity to the U.S. Sixth Fleet in the relatively restricted waters of the eastern Mediterranean. Nevertheless, in a general war, the carrier force might be better employed if it did not operate in relatively fixed

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26/ Alva M. Bowen and Michael Krepon, AEGIS Weapon System: Ship Selection and Related Issues, Congressional Research Service (July 1977), p. 58.

stations in the Mediterranean. Fixed deployments increase the carrier's vulnerability to a surprise attack by reducing the targeting difficulties associated with more mobile deployment. To be sure, complete removal of the U.S. presence could call into question the sincerity of the U.S. commitment to NATO allies and to regional stability and could thus create the very instability the United States seeks to avoid. It is not clear, however, that two carriers must be stationed in the Mediterranean to emphasize those commitments. Some combination of carrier and noncarrier forces might also maintain U.S. credibility in the region. To the extent that such a combination is politically feasible, the probability that one or more carriers would be destroyed in a surprise attack would be lowered and a portion of the force would be freed to operate in other regions during a worldwide war.

Alternatives to Current Methods of Maintaining Overseas Carrier Deployments

Carriers clearly are important tools for maintaining U.S. presence and controlling crises in some of the regions in which they are now deployed. To the extent that other systems might substitute for carriers in certain regions, however, it may be useful to reorient the carrier force to areas in which there is no current operational alternative and/or in which regional military requirements create a greater demand for its presence.

A number of alternatives to the current deployment of U.S. naval forces overseas might be considered. 27/ Each is consistent with a carrier force that is lower than the current 12-unit level. Two of these alternatives, flexible deployments and a new homeporting arrangement, would not involve the addition of new naval systems to the current force. A third alternative would require greater use of land-based aviation for presence operations. A final alternative calls for the introduction into fleet operations of new ship types--smaller units capable of carrying aircraft--and of a new aircraft concept--V/STOL.

27/ These alternatives are discussed at length in Congressional Budget Office, U.S. Naval Forces: The Peacetime Presence Mission.

Flexible deployments would signify a change in naval posture. Instead of operating on permanent stations, carriers would operate in a variety of locales for varying durations. For example, a carrier could deploy for a few months each to different Pacific subregions, instead of operating at all times in one part of the Pacific.

The rationale that underlies a flexible deployment posture stresses the importance of enhancing carrier power but downgrades the political requirement for permanent presence. Flexible deployments would lessen a potential attacker's ability to plan a coordinated strike against carrier forces. They would permit wider operating ranges than the current posture will tolerate. They would facilitate a calibrated force response to crises, since deployed units and carriers operating near the United States could combine into reinforcing groups tailored to the precise capabilities of a regional military threat.

On the other hand, a move to flexible deployments would have to overcome the initial misgivings of states accustomed to benefiting from fixed-carrier stations. These misgivings could reflect skepticism about the credibility of U.S. commitments, which is the very situation that the U.S. overseas posture seeks to avoid.

The second alternative--homeporting an additional carrier overseas--would preserve the current posture but at lower force levels. Homeporting results in a need for fewer carriers to support a given forward station because the Navy adjusts its deployment calculations and considers that all operations other than overhaul take place while "deployed." 28/ It is noteworthy that, if a carrier were homeported in Guam, it could also represent a shift of the carrier force closer to Japan, since Guam is equidistant from Japan and the southwest Pacific.

A third alternative requires the use of non-naval units for the peacetime presence mission. Land-based aircraft now have sufficiently long ranges to conduct operations in regions like the

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28/ The nature of the Navy's calculations and the effects of the technical homeporting adjustment are discussed in Ibid., Appendix A.

Indian Ocean from the bases that remain available to the United States. Certain "intrusive" operations, such as reconnaissance, might prove useful as indications of U.S. concern, particularly in crises. Long-range fighter aircraft, operating from bases in the south Pacific and Indian Ocean, also could underscore U.S. capability to respond to crises 29/ and, indeed, might provide a useful supplement to sea-based units, be they carriers or less-capable ships.

The final alternative calls for the deployment of less capable units in low-threat areas to supplement or to replace carrier forces. Underlying this alternative is the rationale that presence is primarily a political activity and that the permanence of presence is more critical than the capabilities of the units themselves. To be sure, the United States could not credibly deploy ships without some long-range strike capability. Thus, any alternative to the carrier must be a ship capable of carrying aircraft.

The development of V/STOL aircraft permits consideration of several smaller-deck alternatives to the carrier for this mission. These include the LHA, the LPH, and the DDV. The LHA is an amphibious assault ship that actually is as large as a World War II Essex carrier; the LPH is an amphibious helicopter platform that is larger than any cruiser; the DDV would be an air-capable variant of current destroyer types. Both the LHA and the LPH are presently in service with the Marine Corps. The DDV has not yet even been designed. A new LHA could be procured as a follow-on to the class of LHA ships currently under construction. The LPH could be modified to accommodate V/STOL aircraft. The Marines would accept the loss of two LPHs from their force, for modification as V/STOL carriers, if an LHA were procured to replace them. 30/

29/ The recent deployment of unarmed F-15s to Saudi Arabia is another example of the calibrated approach to crisis response that deployment of tactical aviation affords.

30/ See Department of Defense Authorization for Appropriations for Fiscal Year 1979, Hearings before the Senate Committee on Armed Services, 95:2 (March and April 1978), Part 5, p. 4355.

When carrying V/STOL aircraft, all of these ships would provide forward-deployed forces capable of launching tactical air strikes. Indeed, as the following chapter illustrates, if these ships were to carry the advanced AV-8B Harrier aircraft, they could launch strikes several hundred miles inland with several thousand pounds of bombs. This output is comparable, though somewhat smaller, to that of other fixed-wing attack aircraft currently in the fleet.

None of the small air-capable ships could match the capability of the multipurpose air wing of a large-deck carrier. They would all carry fewer aircraft, and their V/STOL planes would be best suited for ground attacks. Nevertheless, because of the improvements in V/STOL capability, small air-capable ships might provide a sufficiently credible level of military effectiveness to underpin their mission of permanent presence in low-threat areas. If they were inserted into current rotations of carrier forces, they could permit lower total carrier force levels for maintaining current overseas stations.

IMPLICATIONS OF WARTIME AND PEACETIME MISSIONS FOR SHIPBUILDING PROGRAMS

Changes in the nature of wartime maritime missions might permit a lower carrier force requirement than the Navy currently postulates. If it is felt that defensive sea control operations could effectively protect the sea-lanes, a number of less costly alternatives might be considered that could enhance AAW and ASW missions as effectively as would procurement of an additional carrier. Given a lower carrier force requirement for wartime operations, a case could then be made for a smaller carrier force than that which the Navy and DoD currently state is required for peacetime missions. Thus, the combination of lower requirements for both wartime and peacetime would lessen the need to procure an additional large-deck carrier. Furthermore, the lower requirements could permit more flexibility in carrying out the carrier Service Life Extension Program (SLEP). That program already may cost more per ship and take longer per ship than originally was planned. 31/ Lower carrier requirements might permit the SLEP

31/ Early estimates for SLEP amounted to $390 million (fiscal year 1980 dollars) for the first carrier; that cost could

program to be extended for a longer period or to be partly curtailed, 32/ without unduly impairing fleet capabilities. A lower carrier requirement would also permit a lower required level of AEGIS air defense escorts. Twelve AEGIS escorts--one for each carrier--are currently programmed for the fleet.

None of the methods outlined above for altering current wartime or peacetime requirements and operations would be cost-free in either political or budgetary terms. For example, a defensive sea control posture could call for additional procurement of land-based aircraft. Small, air-capable ship options would require that these units be procured (or, in the case of an LPH, converted), together with their V/STOL aircraft and possibly escorts as well. Homeporting in Guam would call for additional outlays to fund military construction on the island. Nevertheless, as shown in Chapter V, avoiding some carrier-related expenditures could result in savings, even if any additional funding associated with carrier alternatives is considered. These savings could either be preserved or applied to other programs.

Decisions about carrier wartime and peacetime missions and force levels will also affect the mix of aircraft that is placed aboard each carrier. Indeed, even if an additional carrier is not procured, the missions of the remaining 11 carriers

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increase to more than $515 million (fiscal year 1980 dollars) if SLEP is undertaken in a public shipyard (information provided to CBO by the U.S. Navy, February 15, 1979). SLEP originally was planned to take "about two years" per ship. (Testimony of Admiral J.L. Holloway in Department of Defense Appropriations for 1978, Hearings before the Subcommittee on Defense, House Committee on Appropriations, 95:1 (1977), p. 49.) The first ship is now scheduled to require 28 months. See "USN Aircraft Carrier Programs: Topical Questions and Answers" in Military Posture and H.R. 10929 (Department of Defense Authorization for Appropriations for Fiscal Year 1979), Hearings before the House Committee on Armed Services, 95:2 (February, March, and April 1978), Part 4, p. 421.

32/ This was the case with the service life extension program for the Midway class.

during the next two decades will critically affect the demand for the aircraft they carry. Although a large number of aircraft already in the naval inventory will not be replaced for many years, choices will be made among new aircraft types in terms of their effect on the overall capability of Navy tactical aviation.

If the Navy were to plan a 12-carrier force in anticipation of an offensive sea control posture in a major war, it would require the most capable complement of fighter/interceptors and attack aircraft in order to combat the massed air defenses that task forces would be likely to encounter. On the other hand, if the Navy were to plan its forces in anticipation of a defensive stance that protected the immediate vicinity of the sea-lanes in a major war, it would require its most capable interceptor assets only for the smaller number of carriers required for sea-lane defense. Remaining carriers in the force would serve primarily as a hedge against unforeseen missions; their air wings could perhaps be somewhat less capable than those for which a mission is clearly defined.

Finally, if the Navy were to reorient its peacetime deployment posture, it might require the introduction of ships capable of carrying V/STOL aircraft for missions in low-threat areas. The decision to introduce V/STOL aircraft into the fleet has implications that go beyond the demands of peacetime presence, however. V/STOL could replace all maritime combat aircraft sometime in the future. The deployment of AV-8B V/STOL aircraft in the early to mid-1980s would serve as a proving ground for the potential of this new technology and as a spur to accelerated development of advanced V/STOL types.

As with decisions about the size and mix of the fleet, choices among fighter and attack aircraft programs can be related to the strategies, both wartime and peacetime, which the Navy might pursue. The following chapter examines in detail the implications of different missions for choices among different mixes of aircraft.

CHAPTER IV. REEVALUATING MISSIONS AND FORCES: AIRCRAFT

Chapter III pointed out that appropriate choices in ship procurement depend on Congressional decisions about the missions the Navy should be prepared to undertake. Congressional decisions about procurement of naval aircraft should also follow from decisions about missions.

Regardless of the Congress' decision on an additional aircraft carrier, the United States will have a sizable carrier force for at least two decades to come. Some of the aircraft presently deployed on carriers are reaching the end of their useful service lives. In addition, some observers believe that the number of naval fighter and attack aircraft bought in recent years has been insufficient to maintain full-strength squadrons for all carrier air wings, principally because too many different kinds of planes have been produced. 1/ The Congress must decide what type and number of aircraft to buy as replacements for those on existing carriers and, in addition, for other ships capable of carrying and launching aircraft. This chapter discusses these choices and relates them to alternative judgments about which naval missions should be emphasized. Chapter V presents options that relate ship and aircraft procurement to such judgments. Each option includes enough aircraft to maintain full-strength fighter and attack squadrons for all carrier air wings.

In considering the budget for naval aircraft this year, the Congress faces choices both about vertical or short take-off and landing (V/STOL) aircraft and about conventional take-off

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1/ Aircraft can be built most cheaply if large numbers of planes are turned out by a small number of production lines. Increasing the number of lines increases unit costs and reduces the number of planes that can be procured within a fixed budget. This problem is discussed in Lawrence Korb, "The Fiscal Year 1979-1983 Defense Program--Issues and Trends," AEI Defense Review, Vol. 2, No. 2 (1978), p. 40.

and landing (CTOL) aircraft. With respect to CTOL aircraft, the Congress must decide whether to buy the F-18 for the Navy or to forego F-18 procurement in favor of a fighter force composed entirely of the F-14. Its decisions are important not only because of the costs of the aircraft in question, but also because appropriate choices may differ, depending on Congressional judgments about which naval missions should receive priority.

With respect to V/STOL aircraft, the Congress must decide whether to accept the Administration's cancellation of the Marines' AV-8B V/STOL aircraft program. This decision also will seriously affect whether the Navy's fighter and attack aircraft force will be composed entirely of CTOL aircraft through 1995 or whether V/STOL aircraft will be introduced sooner. This issue is important for two principal reasons. First, V/STOL aircraft are the only means by which the United States can disperse its seagoing airpower to ships smaller than the large-deck aircraft carrier. Decisions about V/STOL can therefore affect the size, composition, and capability of the U.S. fleet over the next two decades. Second, V/STOL aircraft are needed if the Navy is to perform presence missions with converted amphibious ships. This chapter shows that the AV-8B decision might be important for an additional reason: it is possible that carrier attack forces composed of the cost-effective A-18 aircraft 2/ will prove, in some situations, to be less capable than forces composed of the A-7E attack aircraft currently in service. As a result, the Congress may wish to accelerate the introduction into the fleet of V/STOL aircraft on small-deck carriers to supplement the A-18 force on large-deck carriers.

This chapter first discusses V/STOL fighter/attack aircraft. It briefly describes present V/STOL programs and prospects. Next, the chapter discusses CTOL fighter and attack aircraft. It shows that the decision on CTOL fighter procurement will involve a choice between the F-14, which is most effective for defending

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2/ The A-18 is identical to the F-18. Normally, the A-18 will be assigned a ground attack mission and flown by an attack pilot, and the F-18 will be assigned an air-to-air mission and flown by a fighter pilot. The fighter can be used in attack roles and the attack plane in fighter roles, however.

ships from air attack, and the F-18, which is most effective for protecting ground attack aircraft from enemy interceptors. The discussion of CTOL attack aircraft compares a force of 29 A-7E attack aircraft with a force of 24 A-18 attack planes. (The A-18 is slated to replace the A-7E currently in service.) This comparison takes account of the fact that each of these forces requires the same amount of space on a carrier deck. It shows that the A-7E force is more effective (though not more cost-effective) than the A-18 force, except at extremely high levels of sustained attrition.

The chapter closes with a discussion of aircraft mixes that would be appropriate for alternative naval missions. It concludes that an all F-14 fighter force and an all A-18 attack force is cost-effective if the Congress decides to structure the Navy for offensive sea control operations in a major war against the Soviet Union. If the Congress wishes to structure the Navy for defensive sea control operations in a major war but for enhanced power projection capabilities in a lesser contingency, however, some F-18s to protect ground attack aircraft should be procured to give the Navy an F-14/F-18/A-18 mix of fighter and attack aircraft. Advanced V/STOL aircraft are shown to be compatible with either mission orientation.

NAVAL V/STOL

Although the Navy has not made an unqualified commitment to introduce V/STOL aircraft in the future, the present controversy around V/STOL involves not "whether," but "when." Accordingly, discussion of V/STOL aircraft procurement for naval missions currently focuses on two different programs:

- V/STOL "B," a conceptual supersonic fighter/attack aircraft, which cannot be introduced for several years.
- Variants of the AV-8 Harrier attack aircraft currently in service with the Marine Corps. 3/ The Congress must decide whether to fund the AV-8B this year, since the Administration has proposed cancellation of the aircraft.

3/ One Harrier variant discussed in this section is the AV-8B. This aircraft is not the same as V/STOL "B."

V/STOL "B" Aircraft

The Navy's program presents V/STOL "B" as a 1995 replacement for the F/A-18. 4/ The Navy sees V/STOL "B" as a follow-on aircraft because it does not believe that a V/STOL aircraft "competitive with CTOL aircraft in mission performance and in cost" will be feasible until the mid-1990s. Development costs for current-generation CTOL planes have already been paid, while those for high-performance V/STOL aircraft still lie ahead. Therefore, it is clear that V/STOL aircraft would be considerably more costly than equally capable CTOL planes.

Nevertheless, it is plausible to suppose that a V/STOL "B" aircraft competitive with current CTOL aircraft in performance could be introduced well before 1995. Increased funding for research and development might well make V/STOL "B" feasible sooner. 5/ Moreover, others' experience with supersonic V/STOL suggests that it is feasible before 1995. The British government once planned to introduce a V/STOL supersonic strike fighter as early as 1968; some observers believe that such an aircraft could certainly have been in service by 1975. 6/ In addition,

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4/ Two types of systems have been discussed in addition to V/STOL "B": Type "A," a subsonic multimission aircraft, which the Navy once planned to employ in roles presently performed by several different planes but has downgraded from prototype development to continuing study of technologies; and Type "C," a replacement for the light airborne multipurpose system (LAMPS III) helicopter.

5/ V/STOL "B" will be extremely costly to develop, however. The Navy estimates that $5 billion to $8 billion will be required for the task. See Department of Defense Authorization for Appropriations for Fiscal Year 1979, Hearings before the Senate Committee on Armed Services, 95:2 (March and April 1978), Part 7, p. 5502.

6/ These experiences are, of course, difficult to evaluate. The project was cancelled because it proved impossible to reconcile Royal Navy and Royal Air Force requirements for the aircraft. See Derek Wood, Project Cancelled (London: Macdonald and Jane's, 1975), p. 224.

British contractors seem confident that a supersonic V/STOL aircraft is practicable with only "medium risk" involved in development. 7/ In fact, Rolls-Royce claims that, building on the experience of the AV-8A and AV-8B programs, it would be possible to build a flight demonstrator within five years of go-ahead on the program. 8/

AV-8 Aircraft and Variants

Of course, the V/STOL "B" will not enter service for some time to come. The AV-8 Harrier appears, therefore, to offer the only possibility for introduction of V/STOL aircraft into the fleet in the mid-1980s. Moreover, some observers suggest that further development of the Harrier's vectored thrust propulsion system may be the most promising path toward early introduction of the V/STOL "B." 9/

The Marine Corps currently operates the AV-8A, an attack aircraft with very limited range/payload characteristics. 10/ It had intended to replace the AV-8A with an improved version, the AV-8B. 11/ The Defense Department, however, has decided instead to use A-18 aircraft for Marine light attack squadrons.

7/ CBO understands "medium risk" to mean that the problems involved in aircraft development are fairly well understood and are expected to be solved without major advances in technology.

8/ Information provided to CBO by Rolls-Royce, Limited, February 9, 1979.

9/ Ibid.

10/ The Marine Corps will also operate the AV-8C, a modified version of the AV-8A that can carry about 700 pounds more payload than the AV-8A in the vertical take-off mode.

11/ This aircraft, now under development, resembles the current Harrier and is powered by the same engine but incorporates several airframe improvements that are promised to double its range or payload capability.

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Some V/STOL advocates have proposed that the Navy be equipped with a Harrier variant, termed the AV-8B+. This plane would have an upgraded engine and would incorporate a lightweight version of the avionics package (including radar and an inertial navigation system) proposed for the F-18. 12/ These changes are intended to make the AV-8B+ capable of launching the radar-guided, all-weather Sparrow air-to-air missile and the Harpoon antiship missile.

There is some controversy about what AV-8B+ performance and cost imply for U.S. sea-based air capabilities. With respect to performance, there is disagreement about whether any AV-8 aircraft should be given radar missile capability. While the AV-8B's air-to-air capabilities are limited to visual-range "dogfights," the AV-8B+ would be able to intercept aircraft and cruise missiles beyond visual range and at night.

The advisability of procuring the AV-8B+ and its radar-missile capability depends on the role that is envisioned for V/STOL carriers. If the Congress considers that small-deck V/STOL carriers should perform wartime missions within range of Soviet land-based aviation, it may wish to equip them with some capability to intercept attackers. Unless the V/STOL ships were accompanied by large-deck carriers or other surface vessels capable of air defense, development and acquisition of the AV-8B+ or of the V/STOL "B" aircraft would be the only way to provide V/STOL ships with some interceptor protection. 13/ If, on the other hand, the Congress considers that V/STOL carriers are suitable primarily for peacetime presence operations and/or operations in areas beyond the range of Soviet land-based aviation, the case for an interceptor capability aboard the V/STOL ship is much less clear. The AV-8B's air-to-air

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12/ Testimony of Colonel S.P. Lewis, USMC, in Department of Defense Authorization for Appropriations for Fiscal Year 1979, Hearings, Part 7, p. 5105.

13/ It should be noted, however, that an equal-cost force of AV-8B+ (or even V/STOL "B") aircraft and V/STOL ships could not match all the air defense capabilities of a single large carrier equipped with E-2C airborne radar planes and F-14 interceptors.

capability is probably competitive with that of the air forces of most non-Warsaw Pact states. In these latter missions, its primary tasks would be self-defense against enemy fighters, not interception of large-scale anticarrier raids.

Comparative Costs

Regarding costs, official sources argue that the cost of B+ development is quite high (about $1.2 billion in addition to the $200 million development cost of the AV-8B). Advocates contend that this estimate is exaggerated. 14/ While this claim is difficult to evaluate, it does seem that financial constraints will make it difficult to buy AV-8B+ or V/STOL "B" planes and the Administration's proposed F/A-18 aircraft program for the Navy and the Marine Corps. Therefore, going ahead with the proposed F/A-18 program, which is required to meet mid-1980 naval air requirements, could result in postponing the introduction of naval V/STOL aircraft until the late 1990s. Alternatively, the naval air budget could be expanded or procurement of other aircraft, such as the F-14 fighter, could be reduced in order to permit earlier deployment of V/STOL aircraft.

14/ The principal evidence advanced to support this claim involves the British experience in converting their land-based Harrier to a naval aircraft. They reportedly have made changes in their land-based Harrier that were exactly parallel to those involved in converting the AV-8B to the AV-8B+ at a cost of only $200 million. (The only exception, this argument runs, is that the B-to-B+ development calls for improved thrust from the engine, a modification that the British did not make.) It is important to note, however, that the radar with which the British Sea Harrier is equipped is not designed for use with a radar missile like the Sparrow and that the Sea Harrier is armed only with heat-seeking missiles. Further, the radar system on the AV-8B+ cannot be adopted directly from that on the F-18, since development of lighter avionics is required.

CTOL FIGHTERS: F-14 vs. F-18

There is considerable controversy over the choice of a replacement for the F-4 fighter/interceptor, which is reaching the end of its service life. The Navy prefers an all F-14 fighter force; 15/ the Department of Defense has directed that six of the Navy's 24 fighter squadrons be equipped with the F-18 instead. The Defense Department's position seems to be motivated by the judgment that an emerging shortfall in naval fighter inventories might best be remedied by increased procurement of the less costly F-18. This position is the logical outgrowth of the "high/low mix" concepts that lay behind the development of the F-18 as a lower-cost complement to the F-14.

The issues before the Congress in the controversy about naval fighter aircraft are:

- Whether the Navy should procure a "mix" of F-14s and F-18s; and, if it does,
- What the proportion of F-18s should be in the "mix."

Proper answers to these questions clearly depend both on the capabilities and costs of each aircraft and on the missions that the Congress decides to emphasize in making its choices.

This section compares the performance of the F-14 and the F-18. Subsequent sections discuss costs and relate the capabilities of these aircraft to naval missions. The conclusions of both discussions can be briefly stated: The F-14 would be more cost-effective than the F-18 for defending ships at sea from air attack. As a result, the F-14 would be the best fighter for both offensive and defensive sea control missions in the event of a war with the Soviet Union. The F-18 would be more cost-effective than the F-14 for defending ground attack aircraft from enemy fighters. As a result, the F-18 would be the best fighter for power projection missions against countries other than the

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15/ See statement of Admiral James L. Holloway, III, in Department of Defense Appropriations for Fiscal Year 1979, Hearings before the Subcommittee on Defense, House Committee on Appropriations, 95:2 (1978), Part 1, p. 641.

Soviet Union. The primary task of carrier fighters in such situations would not be interception of incoming bombers and cruise missiles, but engaging enemy interceptors.

The F-14 is cost-effective for the fleet air defense mission for several reasons. First, it has a larger and more powerful radar than the F-18, which gives it an advantage in engaging enemy bombers at long ranges. In addition, the F-14 is equipped with the Phoenix air-to-air missile system. The combination of the radar and the Phoenix system enables the F-14 to launch missiles at long range against as many as six incoming targets simultaneously. Finally, the F-14's two-man crew makes it possible to use these systems to greatest advantage in demanding situations such as enemy jamming of the F-14's radar and missiles.

Since the F-18 should have better capabilities to maneuver and accelerate in swirling engagements with other fighters, 16/ it should be a very good "dogfighting" aircraft and probably would be better suited than the F-14 to escort ground attack planes. 17/

16/ The F-14's capabilities in this regard could be enhanced if it were equipped with more powerful engines. Although the Congress appropriated funds in fiscal year 1978 for development of a new engine for the F-14, no decision has yet been made to provide one. The absence of a decision stems in part from the extremely high cost of such a program and in part from some observers' doubts about whether resulting improvements in combat capability are worth the cost. The Navy has estimated that re-engining would cost $3.28 billion for 420 F-14s. See Department of Defense Appropriations: Reprogrammings, Fiscal Year 1977, Hearings before the Subcommittee on Defense, House Committee on Appropriations, 95:1 (1978), p. 206. Since the present F-14 program calls for production of 521 aircraft, F-14 re-engining could cost about $4 billion.

17/ Precise assessment of the F-18's performance is not now feasible, because the aircraft flew for the first time in November 1978 and most of its testing remains ahead. The YF-17, from which the F-18 was developed, has been flown much more extensively, but there are substantial differences between the two aircraft. (For example, the F-18 weighs some 6,000 pounds more than the YF-17.)

The F-18 is smaller than the F-14, which gives it some advantage in air-to-air combat because smaller aircraft are harder to see and thus are less vulnerable to attack. Like the F-14, the F-18 is armed with Sidewinder heat-seeking missiles, an air-to-air 20 mm. cannon, and Sparrow radar missiles. The Sidewinder and gun are limited to air-to-air combat within visual range in clear weather. The Sparrow, which can be used after visually identifying enemy aircraft, also permits engagements beyond visual range, at night, and in bad weather. The fact that the F-18 lacks Phoenix air-to-air missiles is not a drawback in dogfights with enemy fighters. The Phoenix was designed primarily for use against bombers, which are much larger and less maneuverable than fighters and which would be engaged many miles beyond visual identification range. One possible disadvantage of the F-18 compared to the F-14 in the dogfighting role is that it is a single-seat plane. Many Navy fliers consider this a serious drawback, since the "backseater" in the F-14 can assist the pilot in looking for and/or tracking enemy planes while operating the aircraft's weapons systems at the same time. 18/ In contrast, all of these tasks must be performed by one man in the F-18.

Although the available quantitative measures are only rough proxies for complex differences between the F-14 and the F-18, these measures can illustrate the differing capabilities of the F-14 and the F-18 for a given mission. Thus, if the primary function of any carrier-based fighter is judged to be interception of bombers and missiles that threaten the carrier, the number of radar missiles that can be launched provides a crude measure of single aircraft effectiveness. According to this measure, the F-14 is roughly three times as capable as the F-18. 19/ On the other hand, if aerial dogfight and strike escort capabilities are the subject of quantitative assessment, ratios of an aircraft's weight to either the thrust

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18/ Bert Cooper, F/A-18 HORNET-Background Analysis, Congressional Research Service (December 15, 1978), p. 22.

19/ This ratio applies even under the extremely optimistic assumption that the F-18 could fire a Sparrow, guide it to its target, and then repeat the process against a second target.

of its engines (termed "thrust-to-weight") or to the area of its wings (termed "wing loading") could be computed for both aircraft and compared. According to these measures, the F-18 enjoys an advantage of some 23 percent in acceleration and 18 percent in maneuverability. 20/ (One cannot, however, conclude that the F-18 is between 18 and 23 percent better than the F-14 for dogfighting and strike escort roles. Several factors are not considered in the comparison, 21/ and many of them cannot easily be quantified.) 22/

These crude quantitative measures illustrate that the nature of the mission determines whether the F-14 or the F-18 is a better aircraft. Therefore, any Congressional decision about whether to procure both aircraft, and in what proportion, partly depends on a prior judgment about the kinds of missions that should be emphasized in structuring carrier aviation and about the extent to which the Congress wants to "hedge" against the prospect of performing other missions. 23/ Any Congressional decision must also take into account procurement and operating costs, which are discussed later in this chapter.

20/ These percentages are based on data provided in Doug Richardson and Graham Warwick, "The Air Superiority Fighter," Flight International (January 6, 1979), p. 16.

21/ For example, the "wing-loading" measure tells something about the relative turning ability of different aircraft but has marked limitations in comparing the fixed-wing F-18 with the swing-wing F-14. (The F-14 can compensate somewhat for its relatively unimpressive wing-loading characteristics by changing the sweep of its wings in the course of a turn.)

22/ For example, the two seats of the F-14 are a substantial advantage in aerial combat. It would be inappropriate, however, to conclude that this difference implies that the F-18 is only half as good for such missions as the F-14.

23/ Since such judgments are closely related to attack aircraft issues, they are discussed later in this chapter.

CTOL LIGHT ATTACK AIRCRAFT: A-7E vs. A-18

Both the Navy and the Department of Defense want to phase out the A-7E light attack aircraft now in use on carriers. Their replacement choice is the A-18, which is identical to the F-18 but has a different designation to denote its different mission. (A-18 pilots will be trained primarily for air-to-surface, rather than for air-to-air, missions.) Current plans call for replacing the entire A-7E force by 1989, although some A-7Es will be phased from the active force before the end of their active 15-year service life. 24/

A close examination of the capabilities and costs of attack forces that take an equal amount of carrier deckspace reveals that the A-7E force actually is more effective than the A-18 force in many combat environments, even when performance estimates made by the Navy and the A-18's contractor are assumed. Only comparative costs make the A-18 the preferred option. This finding could influence decisions on the pace of V/STOL development. If the A-18 does not perform as expected when it enters the fleet, the Navy might find itself operating less effective attack aircraft forces in the 1980s than it could today. Accelerating the V/STOL "B" program to provide additional attack aircraft, deployable on smaller ships, could serve as a hedge against this possibility.

A-7E vs. A-18: Capabilities Compared

The A-7E and the A-18 are similar in several respects. Both are single-seat attack aircraft designed for daylight, clear-weather missions, although the A-18's radar gives it some capability to conduct strike missions in inclement weather. Both aircraft can deliver the same kinds of ordnance, with only marginal differences in accuracy. 25/

24/ Information provided to CBO by the U.S. Navy, January 15, 1979.

25/ The A-18's bombing system is advertised to be more accurate than the A-7E's. The A-7E's system is already so accurate, however, that the A-18's improved system will not significantly increase the destructive effectiveness of its bombs.

In other respects, however, there are significant differences between these planes (see Table 3).

TABLE 3. CTOL ATTACK AIRCRAFT COMPARISON

A-7 Advantages	A-18 Advantages
Greater Range/Payload	Greater Survivability
Less Deckspace Required/ Larger Force	Greater Availability (reliability, maintainability, and commonality) a/

a/ Reliability refers to the amount of time between failures of important aircraft components. Maintainability refers to the amount of maintenance man-hours required on an aircraft for each hour that it is airborne. In conjunction with F-18/A-18 commonality, these improvements are supposed to result in increased levels of availability for use. Therefore, the phrase "availability advantages" often will be used in this paper to refer to these attributes.

Deckspace and Payload. The A-7E has some advantages over the A-18. It takes up less space on a carrier deck, so that a carrier with room for 24 A-18s can carry 29 A-7Es or 24 A-7Es and more of some other kind of aircraft. The A-7E also has a 10 percent advantage in range/payload performance compared to the A-18. In other words, the A-7E can deliver the same ordnance payload at greater distances than the A-18, or stay on station for longer periods of time while performing close air support missions. Similarly, for targets at a fixed distance, the A-7E can deliver a larger payload than can the A-18.

Survivability. One of the A-18's principal advantages over the A-7E is predicted to be its greater individual survivability in combat. The A-18 has superior maneuverability and greater

capability for acceleration and speed. In addition, the A-18 incorporates a number of features which, according to the Navy, make its vulnerable area much smaller than that of the A-7E, even though the A-18 is a larger aircraft. 26/ Further, Navy computer simulations suggest that, despite its larger size, the A-18 typically appears about the same size as the A-7E to the naked eye. Similarly, it has a roughly equivalent or smaller radar cross section than the A-7E, depending on the kind of radar used to detect it.

Another feature which enhances the survivability of an attack force of A-18s is that it can be used as a highly capable fighter if an appropriately trained pilot is available, while the A-7E cannot. The inherent flexibility of the A-18 might be of considerable importance early in a campaign, when the principal task of a carrier wing could be the defeat of an enemy fighter force to permit later strikes against surface targets. 27/

While aircraft characteristics indicate that the A-18 is more survivable than the A-7E, they do not indicate how much more survivable it is. The Navy has cited campaign analyses which found the A-18 to be 2.5 to 3 times more survivable than the A-7E. 28/ Such an estimate implies that A-18s might be employed in attacks that A-7Es could not make because of prohibitive

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26/ These features include self-sealing fuel tanks, wing-tank foam for explosion suppression, redundant hydraulic and electric flight controls, and a fire extinguisher system.

27/ This does not mean that 24 A-18s on a carrier automatically represent 24 "extra" fighter aircraft. The Navy does not currently train pilots for both attack and fighter missions, although attack pilots do receive training in defensive air combat maneuvering. Making A-18 pilots fully capable of both attack and all-weather fighter missions would increase the demands placed on pilots and on existing training resources. A-18s with attack pilots represent an equally capable fighter resource only to the extent that such training is performed, however.

28/ Information provided to CBO by the Office of Legislative Affairs, U.S. Navy, October 10, 1978.

losses. In addition, it is critical in evaluating the A-18's cost-effectiveness.

Availability Advantages: Maintainability, Reliability, and Commonality. The fraction of an A-18 force that would be available to participate in a given raid should be larger than the corresponding fraction of an A-7E force, as a result of two features of the A-18: its commonality with the F-18 and the reliability and maintainability improvements incorporated into the aircraft. F-18/A-18 commonality is expected to result in fighter aircraft being available for attack missions when sufficient numbers of attack planes are not. Commonality also eases maintenance problems: when both F-18s and A-18s are aboard the carrier, "fighter" spare parts and maintenance personnel could be used if needed on "attack" aircraft, and vice versa. Finally, increased reliability and maintainability should mean that the proportion of an A-18 force available to participate in a given strike would be larger than the corresponding proportion of an A-7E force.

Improvements in A-18 availability ought to follow from the factors just described. It is hard to predict the extent of these improvements, however, because the Navy has not yet had any experience with the F/A-18 in fleet operations. Dramatic improvements in A-18 availability are nevertheless promised to flow from these features. McDonnell-Douglas, the A-18's contractor, expects an F-18/A-18 force to show a 24 percent improvement over the availability of an F-14/A-7E force. It should be noted, however, that the 24 percent availability advantage is unlikely to be borne out by actual A-18 performance. 29/ For example, a 24 percent availability advantage is unlikely in A-18 operations if F-14s rather than F-18s make up the carrier fighter force, since an F-14/A-18 force enjoys none of the availability enhancements that flow from F-18/A-18 commonality.

A-7E vs. A-18: Comparative Effectiveness

The purpose of carrier attack aircraft is to deliver ordnance against enemy targets. If one aircraft requires less deckspace than another, or has greater range/payload capabilities, or is

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29/ For further discussion of these points, see Appendix A.

more available or more survivable, it has an advantage over the other because it can deliver more ordnance over a given period of time. An analysis of A-7E and A-18 performance that takes these attributes into account leads to the following conclusions: 30/

- Even if the A-18 is credited with the 175 percent survivability advantage predicted by the Navy and the 24 percent availability advantage expected by its manufacturer, an equal-deckspace force of A-7Es is more effective than one of A-18s, except at extremely high levels of sustained attrition. 31/

- Nevertheless, the A-7E is less cost-effective than the A-18 for virtually any level of attrition. 32/

- The availability advantage attributed to the A-18 is the most critical factor in determining its effectiveness relative to the A-7E.

30/ This analysis is provided in detail in Appendix A.

31/ "Extremely high" sustained attrition levels are defined to be 5 percent (1:20) or greater for the A-7E (see Appendix A).

32/ Last year, the F/A-18 program was opposed in the Congress on grounds that the F-14 was a superior fighter/interceptor and that the A-7E was more effective and cheaper. The analysis reported above suggests that this assessment of the A-7E vs. A-18 choice was substantially correct last year. At that time, no F/A-18s had been produced and a total buy of 800 aircraft was proposed, with the maximum production rate expected to be 108 aircraft per month. Development and procurement costs could proportionally be charged to Navy missions, since the 800-aircraft buy would not cover both the Marine fighter requirement and the Navy's peacetime need for attrition replacements. This year, 1,377 aircraft are expected to be produced, at a maximum rate of 186 per month, for both the Navy and the Marine Corps. These factors reduce the average cost of all F/A-18s and imply that A-18 costs must be calculated on the margin of a buy of F-18s for the Marines, even if no F-18s are procured for the Navy. In these circumstances, the A-7E is not cost-effective.

The Choice of A-18 and Prospects for V/STOL

These conclusions are relevant to Congressional decisions this year because the analysis clearly indicates that, if the A-18's availability advantage over the A-7E proves to be less than McDonnell-Douglas suggests, the A-18 might prove to be less effective than the A-7E, even at extremely high levels of sustained attrition. In view of these considerations, the Congress may wish to hedge against the possibility that the A-18 will not in fact achieve the desired level of availability. A hedge could be provided in several ways. One way that is particularly relevant to Congressional budget decisions this year would be continuation of the Marines' AV-8B program and funding of research and development on the V/STOL "B" aircraft that is expected to follow the A-18 in naval service. 33/ Such decisions might lead to the introduction of V/STOL "B" before 1995 and thus permit V/STOL attack aircraft to be deployed on smaller ships to supplement A-18s aboard large carriers.

RELATING AIRCRAFT TO MISSIONS

Appropriate Sea-Based Aircraft for Operations in a Major War

In discussing the sea-based aircraft requirements for a major war against the Soviet Union, it is again convenient to distinguish between defensive sea control and offensive sea control (and power projection) operations.

F-14s Required for Both Offensive and Defensive Sea Control. In defensive sea control operations, carrier-based fighters could help protect the sea-lanes by providing part of the air defense

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33/ Another way of providing a hedge would be continued procurement of some A-7E aircraft, in order to keep a "warm" production base that could be expanded later. This course is unlikely to be cost-effective, however, for reasons noted below. Moreover, if a fixed budget for aircraft procurement is assumed, production of the A-7E in addition to production of the F/A-18 would preclude reduction of the number of open production lines of naval aircraft and might therefore reduce the total number of planes the Navy could buy.

gauntlet described in Chapter III. For offensive sea control missions against Soviet bases, highly capable interceptors would be required to meet the onslaught of bombers and cruise missiles launched against the attacking carriers. The F-14 seems to be more cost-effective than the F-18 for both roles. The F-14's radar and Phoenix missile system afford it a long-range and multiple-intercept capability that the F-18's radar and Sparrow missile systems cannot match. 34/

A-7E and A-18: Unneeded for Defense; Effective for Offense. The issue with respect to light attack planes for defensive sea control in a major war with the Soviet Union is not a choice among A-7Es, A-18s, or some kind of V/STOL attack aircraft. Instead, it involves the extent to which such planes are needed at all for this purpose, since they are primarily useful for attacking Soviet surface ships. They cannot counter the Soviet submarine and bomber fleets, which comprise the greatest threat to U.S. control of the seas. 35/ Moreover, the A-6 medium all-weather attack aircraft on each carrier should be able to attack any Soviet surface units before they come within striking distance of the carrier. Therefore, a better use for most of the light

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34/ Proposed follow-on missiles might give the F-18 a multiple-intercept capability, but the F-18 radar will remain a short-range system.

35/ Of course, it might be argued that the presence of light attack squadrons composed of A-18s would represent a welcome hedge against Soviet bombers, since the A-18 has some interceptor capability while the A-7 has none. If contingencies requiring additional air defense units on a carrier arose in time of war, however, the Navy could allocate more F-14s to that carrier. Such a policy would incur costs, even if only a few F-14s were used. Augmentation from the Fleet Readiness Squadrons would reduce the Navy's ability to train new pilots; augmentation from the air wings of carriers in overhaul would reduce these carriers' combat potential; augmentation from peacetime attrition stocks may not be feasible, depending on the level of stocks when the war starts. Nevertheless, it would be possible to use aircraft from these sources if preparations to do so were made in peacetime and if wartime needs proved sufficiently critical.

attack planes might be to position them at land bases within range of carriers engaged in offensive sea control (or power projection) missions, so that they could replace combat losses of light attack aircraft from those carriers. 36/

In offensive sea control missions, attack aircraft are likely to be subject to very high attrition. The effectiveness of the A-18 relative to the A-7E depends on the exact levels of attrition and on the availability advantage that would characterize actual A-18 operations in attacks against Soviet targets, factors that are very difficult to predict. Costs, however, dictate a choice in favor of the A-18. The disadvantages in effectiveness of the A-18 force are more than outweighed by its lower cost. 37/

V/STOL in Projection Operations Against the Soviet Union. The utility of V/STOL aircraft for use in power projection operations against the Soviet Union is more problematical. On one hand, it seems clear that no V/STOL aircraft could match the output of a CTOL plane embodying the same level of technology in engine performance, lightweight avionics, and airframe materials. On the other hand, V/STOL aircraft would permit attack operations from ships other than large-deck aircraft carriers. This is important if it is assumed that large carriers and their escorts could provide an "umbrella" of anti-air and antisubmarine defenses. Given such protection, smaller air-capable ships like LPH and LHA amphibious helicopter carriers could, if converted into V/STOL carriers, join large-deck carrier battle groups in offensive sea control operations. Ten of these smaller-deck ships are already in the fleet, and two more are

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36/ It might be argued that, if this is the best use for light attack aircraft on carriers defending the sea-lanes, the Navy has too many light attack planes. Such an argument does not take into account the utility of fully equipped carriers for their other missions, however.

37/ Current cost estimates suggest that the A-18 is cheaper than the A-7E on the basis of life-cycle costs per aircraft. In addition, A-7E costs must be multiplied by 1.21 before being compared to A-18 costs, because the effectiveness analysis compared the output of equal-deckspace forces of 24 A-18s and 29 A-7Es, and 24 x 1.21 = 29.

being built. In operations from converted amphibious ships, the AV-8B--and certainly the V/STOL "B"--could make an important, though supplementary, contribution to sea-based aviation attack capability.

Appropriate Sea-Based Aircraft for Operations in a Lesser Contingency

Because of its mobility, carrier aviation is highly suitable for strikes against non-Warsaw Pact opponents. A carrier aviation force mix best suited for a major war against the Soviet Union might not be equally appropriate for the more likely contingency of use against a third country, however. The tasks facing naval aviation could differ markedly between a major war and lesser contingencies, primarily because of the disparity between Soviet anticarrier capabilities and those of other states.

F-18 Both Effective and Cost-Effective for Lesser Wars. The Congress might choose to equip some carriers with F-18 fighters in anticipation of the requirements of a lesser war against a non-Warsaw Pact opponent. The rationale for such a decision would be threefold. First, the F-14 would not be needed for fleet air defense, since such adversaries are unlikely to be capable of mounting large-scale, coordinated cruise missile and bomber attacks against carriers in the foreseeable future. Second, the F-18 would be superior to the F-14 in the strike escort role. Finally, the F-18 promises to be considerably cheaper than the F-14 in terms of life-cycle costs. 38/

38/ A large number of F/A-18s is slated to be produced each year, and total production is expected to be 1,377 aircraft, compared to 521 for the F-14. This factor drives down the F-18's procurement costs sharply. Even if the present F/A-18 program were drastically reduced by a decision not to buy either A-18s for the Navy and Marines or F-18s for the Marines, however, the life-cycle cost of the F-18s needed to equip six squadrons would still be cheaper than the life-cycle cost of the F-14s needed to equip six squadrons. This is because the F-14 is much more costly to maintain than the F-18 is promised to be and because the operating and support costs of the F-14 must also cover the costs of a two-man crew, in comparison to the one-man crew of the F-18.

Effectiveness of CTOL Attack Aircraft Dependent on the Choice of Fighter. The relative effectiveness of CTOL attack aircraft depends on the type of fighter aircraft aboard the carrier. For example, the case for an A-18 attack force would be strongest if the carrier's fighter force were composed of F-18s. F-18/A-18 commonality would ease maintenance problems and permit substitution of fighters for attack planes and vice versa, thereby increasing the availability of the A-18. 39/

An A-18 attack force is likely to be less effective per carrier deck load relative to an A-7E attack force, however, if the carrier's fighter force is composed of F-14s. Nonetheless, the A-18 would remain cost-effective for reasons noted above.

V/STOL as Attack Aircraft for Lesser War Missions. V/STOL aircraft could also be used for attack missions in a lesser war. If U.S. ships were likely to be engaged by Soviet aircraft and submarine forces, V/STOL smaller-deck carriers would need to be part of a carrier battle group, for reasons outlined in the discussion of V/STOL planes in a major war. In other situations, much would depend on the particular circumstances of the war and on the availability of other systems that could operate in conjunction with the V/STOL carrier. For initial strikes, it would appear that the capability of V/STOL aircraft against land targets is far from negligible. Table 4 indicates that the AV-8B could carry 6,000 pounds of bombs for more than 250 miles; the performance of the V/STOL "B" would be considerably better. Given the coastal location of many major cities and military installations in the Indian Ocean and southwest Pacific, even a small air-capable ship with V/STOL planes could inflict

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39/ Of course, F-18 pilots could fly their aircraft on attack missions even if the attack squadrons were composed of A-7Es. Some degradation of attack capability might well result, however, since F-18 pilots would probably not have been completely trained as attack pilots. By contrast, some of the F-18s on an all F-18/A-18 carrier could be flown by attack pilots from the A-18 squadrons. Similarly, some of the A-18s could be used as fighters to gain air superiority early in a campaign, thus enhancing the survivability of attack aircraft in subsequent raids. This would not be true if the carrier was equipped with an F-18/A-7E mix.

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considerable initial damage against targets in those regions. In addition, the vertical landing capability of V/STOL aircraft frees the ship from the limitation on sortie rates imposed by the launch and recovery cycles that characterize operations aboard a CTOL large-deck carrier. As a result, the actual ordnance deliverable by a squadron of AV-8Bs is probably greater than the data provided in Table 4 would suggest.

TABLE 4. RANGE AND PAYLOAD CAPABILITIES OF VARIOUS CARRIER ATTACK AIRCRAFT

Type of Mission Flown	Ordnance Load (Number of MK-83 1,000-Pound Bombs)	Aircraft	Combat Radius (Nautical Miles)
High-Altitude Approach, Low-Altitude Attack	4	A-7E	660
	4	A-18	597
	4	AV-8B	470
	6	A-7E	492
	6	A-18	466
	6	AV-8B	256
High-Altitude Approach, High-Altitude Attack	4	A-7E	990
	4	A-18	915
	4	AV-8B	670
	6	A-7E	810
	6	A-18	730
	6	AV-8B	400

SOURCE: Department of Defense Authorization for Appropriations for Fiscal Year 1979, Hearings before the Senate Committee on Armed Services, 95:2 (March and April 1978), Part 7, p. 5054.

As noted above, V/STOL aircraft might also prove useful for antiship missions. For example, the AV-8B's Harpoon capability will make a "Harrier carrier" more than a match for Soviet surface ship anticarrier task forces, except in the event of a surprise attack. Finally, apart from its own capabilities, the greatest contribution of the V/STOL ship and its aircraft might be indirect. By substituting for a large-deck carrier, a V/STOL smaller-deck ship could free some part of the large-deck carrier force from fixed deployments and realize the inherent potential of mobile air power for U.S. strategic flexibility. Thus, even though V/STOL aircraft like the AV-8B would not be competitive with CTOL aircraft in major wars, they could yield substantial benefits to the fleet in the day-to-day conduct of presence operations.

CONCLUSIONS

The foregoing discussion suggests that an all F-14 fighter force and an all A-18 attack force is cost-effective if the Congress decides to structure the Navy for offensive sea control operations in a major war against the Soviet Union. If the Congress wishes to structure the Navy for defensive sea control operations in a major war but for enhanced power projection capabilities in a lesser contingency, however, some F-18s should be procured to give the Navy an F-14/F-18/A-18 mix of fighter and attack aircraft. Advanced V/STOL aircraft are compatible with either mission orientation. The Congress may wish to procure them to disperse aircraft at sea, to help perform peacetime presence missions, or to hedge against the possibility that the cost-effective A-18 force will prove to be less effective than the A-7E force it replaces.

CHAPTER V. BUDGET OPTIONS FOR FISCAL YEARS 1980-1984

In fiscal year 1980, the Congress faces several major ship and tactical aviation procurement decisions whose implications extend to the budgets of ensuing fiscal years as well. These decisions will involve choices among competing types of air-capable ships, including two variants of the large-deck aircraft carrier, the conventionally powered CV and the nuclear-powered CVN; the mid-sized conventionally powered CVV; and smaller V/STOL carriers. These choices could also affect escort procurement levels (specifically, the number of AEGIS escorts required for the fleet) and the mix of tactical aircraft procured.

The decisions on tactical aircraft center on three programs: the F/A-18 fighter/attack aircraft, the F-14 fighter/interceptor, and the AV-8B V/STOL attack plane. The current F/A-18 program calls for 15 units to be procured in fiscal year 1980, at a cost of $1,044 million. Thereafter, the aircraft are to be procured in escalating quantities for several years--48 units in 1981, at a cost of $1,380 million; 96 units in 1982, at $1,683 million; 108 planes in 1983, at $1,612 million; 1/ and 186 planes in 1984, at $2,180 million. This purchase will provide six active F-18 squadrons (12 planes per squadron) that will share fleet fighter duties with 18 F-14 squadrons. Together, the 24 squadrons will provide the programmed 12 carrier wings with two fighter squadrons each. Should the Congress elect to expand the requirement for active F-18 squadrons, however, the F-14 requirement could be reduced. Alternately, a decision to procure more F-14s would lower the requirement for F-18 fighters. The F-14 procurement program, as currently planned, is nearly two-thirds complete. A higher F-14 requirement could result

1/ The decrease in funding levels between fiscal years 1981 and 1982 reflects differing advance funding for future aircraft, differing percentages of prior-year funding for each year's program, and the effect of decreased unit price with longer production runs.

in larger purchases both in 1980 and in ensuing fiscal years; a lower requirement could terminate production within the current five-year program. Because the program for naval F-18 fighters is only a subset of the total F/A-18 program for the Navy and Marine Corps, adjustments in the F-18 requirement would not affect the F/A-18 program for the next five fiscal years. For similar reasons, alterations in the programmed carrier force level would not be reflected in the F/A-18 program for fiscal years 1980-1984 but could affect procurement of the F-14 in those years.

The AV-8B, unlike the fighters, has not been included in the fiscal year 1980 budget and, indeed, the Administration has effectively terminated the program. 2/ The Administration has provided $16 million for V/STOL research and development, presumably for longer-range V/STOL programs. If the Congress wishes to procure small air-capable ships to operate in the mid-1980s, it will also have to procure AV-8B V/STOL aircraft for them. Furthermore, a Congressional decision to accelerate the introduction of V/STOL into the fleet could result in increased development funding for the AV-8B in fiscal year 1980 in order to permit procurement of the Navy's first active V/STOL attack planes as early as fiscal year 1982.

Decisions about ship and aircraft procurement will depend on anticipated mission requirements and, specifically, on whether the Congress expects or desires the Navy to pursue offensive or defensive missions in a worldwide war. Residual factors affecting these decisions will be Congressional views about the appropriate maritime posture that the United States should adopt in peacetime and, related to this question, the speed with which the Congress wishes the Navy to move toward deployment of V/STOL aircraft on naval vessels. Wartime requirements dominate the choices, however, for they set minimum requirements for forces. Peacetime requirements are second-order considerations that can only add to that minimum; choices relating to systems characteristics reflect third-order decisions about optimum means for carrying out agreed-upon missions.

2/ See U.S. General Accounting Office, Is the AV-8B Advanced Harrier Aircraft Ready for Full-Scale Development?, PSAD-79-22 (January 30, 1979), p. iv.

The following options are organized to illustrate the force and budgetary implications of pursuing offensive, as opposed to defensive, wartime sea control strategies. Subsumed within the options, however, are examples of alternative approaches to the second-order question of peacetime presence requirements and the third-order issue of choosing between competing ship characteristics, such as conventional and nuclear propulsion, and between aircraft characteristics, such as conventional or vertical take-off and landing capabilities. The following table sets out the options to be described below.

TABLE 5. COMPONENTS OF ILLUSTRATIVE OPTIONS

	Options			
	I	II	III	IV
Wartime Missions	Defensive	Defensive	Offensive	Offensive
Peacetime Posture	Unchanged	Altered	Altered	Unchanged
Weapons System Characteristics				
New Carrier a/	Conventional/ mid-sized	None b/	Conventional/ large- b/ deck	Nuclear
Aircraft a/	CTOL only	CTOL/VSTOL	CTOL/VSTOL	CTOL only

a/ For specific types, see Table 10 below.

b/ Includes conversion of amphibious ships to small-deck aircraft carriers.

OPTION I: EMPHASIZING DEFENSIVE WARTIME MISSIONS BUT MAINTAINING CURRENT PEACETIME POSTURE

The Congress could choose to adopt a program similar to that proposed by the Department of Defense. This program would attach greater importance to defensive carrier operations in a general war but would hedge against a possible need for offensive sea control, while fully accepting the assumption that peacetime presence demands permanent visibility of the most powerful air-capable unit, the conventional carrier. While the Congress might also determine that carrier forces are inefficiently deployed in peacetime, it could still attach greater importance to avoiding negative political reactions from allies and neutral countries that might result from any alteration of the current posture. The Congress might therefore support procurement of an additional carrier to permit four forward deployments in peacetime while the Navy undertakes service life extension programs. 3/

In accepting that primarily peacetime rather than wartime requirements call for an additional carrier for the fleet, the Congress, like the Department of Defense, might, however, wish to minimize the future costs of maintaining fixed deployments. In that spirit, it might choose to authorize and appropriate funds for a mid-sized, conventionally powered carrier, the CVV. This carrier would be viewed primarily as a "filler ship" that would permit current deployment stations to be maintained intact. It could also contribute to sea-lane protection in the event of war. If configured solely for anti-air and antisubmarine warfare, a CVV would cost $1.6 billion and could carry the

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3/ The Congress might also view an additional carrier as enhancing naval flexibility in case other deployments prove necessary in future years. Should those requirements materialize, the Congress could then undertake the necessary military construction required to homeport a carrier at, for example, Guam. In so doing, it could support additional deployments without having to procure additional carriers. Since construction of facilities to permit homeporting at Guam would take less time than construction of a new carrier (which currently extends up to eight years), new deployments could be implemented more quickly, in response to the perceived need for them.

same number of AAW and ASW aircraft as a larger, nuclear-powered CVN, which costs approximately $2.6 billion.

A decision to procure an additional carrier to support current deployments would also be consistent with several other DoD programs. First, such a decision would be in accord with the current DoD program for procuring AEGIS air defense escorts. These escorts are meant to enhance the fleet's AAW capabilities. DoD's five-year plan includes procurement of 10 additional DDG-47 destroyers to supplement the lead ship that was authorized in fiscal year 1978. The complete program is expected to provide at least one DDG-47 escort for each of the 12 carriers. 4/

Second, a decision to procure an additional carrier primarily for peacetime purposes, rather than to enhance the offensive sea control effort, would be consistent with the proposed DoD purchase of F-14 and F-18 fighter aircraft. The F-14 aircraft would be necessary to support the Navy's defensive sea control mission, to which primary importance is attached and which, as noted in Chapter III, calls for the use of nine of the Navy's carriers (including the two in overhaul). The Administration's F-14 request would provide sufficient aircraft to give nine of the Navy's carriers two F-14 squadrons each.

The F-18 aircraft would be deployed on the remaining carrier decks. They would be geared to support the operations of those carriers in lesser contingencies in which the bomber threat might not be as great and in which the F-14's superior capabilities

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4/ Statement of Admiral Thomas B. Hayward, Chief of Naval Operations, on "The Fiscal Year 1980 Military Posture and Fiscal Year 1980 Budget of the United States Navy," before the House Committee on Armed Services (February 2, 1979; processed), p. 64. DoD appears to accept a requirement for enhanced AAW protection of underway replenishment groups and/or carriers in high-threat areas. To this end, it has requested funds for improved Tartar air defense systems, two of which will be placed on the two destroyers that are being requested in the fiscal year 1979 supplemental budget request. In addition, DoD is planning a new major destroyer type, the DDX, which would supplement the DDG-47. U.S. Department of Defense, Annual Report, Fiscal Year 1980, p. 168.

would, therefore, be less critical to the success of Navy missions. F-18s could also be employed as escorts for attack aircraft if the Navy should undertake an offensive sea control operation.

Finally, the Congress could adopt the A-18 portion of DoD's Navy tactical air program in addition to the F-14 and F-18 programs outlined above. Because procurement of a carrier permits the Navy to mount a significant carrier force for offensive sea control operations in the Pacific without drawing upon carriers required for other theaters, the Congress might wish to enhance the fleet's capability to conduct attacks against Soviet defenses. The A-18 might be viewed as the appropriate plane for such a mission. In addition, the A-18 might be favored for use in lesser contingencies, since F-18s are also procured in this option. Because of F-18/A-18 commonality and the availability of F-18 escorts, the A-18 would be more available for attack missions. No AV-8Bs would be procured in this option, and funding for enhanced V/STOL development would be relatively limited.

Table 6 indicates that the cost of this option would amount to $4.2 billion in investment funds (in the shipbuilding and naval aviation accounts) for fiscal year 1980 and approximately $21.7 billion over the next five fiscal years. 5/

OPTION II: EMPHASIZING DEFENSIVE SEA CONTROL IN WARTIME AND A NEW DEPLOYMENT POSTURE IN PEACETIME

The Congress could accept the idea that defensive sea control would be sufficient for sea-lane protection in a major war and that offensive operations would only need to be conducted in less demanding contingencies. The Congress could also consider that postures other than fixed-carrier deployments would satisfy U.S. peacetime presence requirements and that V/STOL aircraft would be appropriate for that mission. It could then choose to support a budget program that did not provide for procurement of another carrier.

5/ Costs of the F-18/A-18 program assume acceptance of the proposed purchase of F-18/A-18s for the Marines.

TABLE 6. OPTION I: EMPHASIZING DEFENSIVE WARTIME MISSIONS BUT MAINTAINING CURRENT PEACETIME POSTURE, SYSTEMS INVESTMENT COSTS FOR FISCAL YEARS 1980-1984: BY FISCAL YEAR, IN MILLIONS OF FISCAL YEAR 1980 DOLLARS

	1980		1981		1982		1983		1984		Total	
Unit	Number	Cost	Number	Cost	Number	Cost	Number	Cost	Number	Cost	Number	Cost
CV (Kennedy) a/	--	--	--	--	--	--	--	--	--	--	--	0
CVV	1	1,624	--	--	--	--	--	--	--	--	1	1,624
CVN a/	--	--	--	--	--	--	--	--	--	--	--	0
CV/SLEP	--	50	1	478	--	41	1	427	--	12	2	1,008
LPH (conv) b/	--	--	--	--	--	--	--	--	--	--	--	0
LHA b/	--	--	--	--	--	--	--	--	--	--	--	0
DDG-47	1	825	2	1,481	2	1,424	3	2,172	2	1,416	10	7,318
CGN-41 c/	--	--	--	--	--	--	--	--	--	--	--	0
F-14	24	666	24	696	24	708	24	704	24	684	120	3,458
F-18 A-18	15	1,044	48	1,380	96	1,683	108	1,612	186	2,180	453	7,899
V/STOL R&D	--	17	--	45	--	65	--	88	--	131	--	346
Total Cost		4,226		4,080		3,921		5,003		4,423		21,653

a/ Large-deck carriers, which are not included in this option.

b/ Program for small-deck carriers for V/STOL aircraft, which are not included in this option.

c/ Nuclear-powered AEGIS cruiser, which is not included in this option.

If the Congress is satisfied with the current forward disposition of carrier forces but wishes to support them with fewer operational carriers, it could fund the construction of facilities at Guam to provide for homeporting a carrier there. Such an arrangement would permit the maintenance of current stations with an 11-carrier force. Its cost would amount to $250 million (fiscal year 1980 dollars) for military construction.

If the Congress prefers to maintain permanent naval presence overseas but attaches less importance to the need for carriers to perform this task in low-threat areas, it could support procurement of small V/STOL ships in place of an additional large-deck carrier. These smaller ships vary in both size and cost, though all would be less costly than any carrier type. The LHA costs $820 million to procure; the LPH requires only conversion, at a cost of $45 million. Two converted LPHs could carry as many planes as an LHA. Converting two amphibious LPHs to V/STOL carriers would reduce the number of deck spots available to the Marines, however. Thus, an LPH conversion, while it would facilitate the speedy entry of an air-capable ship into the fleet, would also incur the cost of an LHA. (The Senate anticipated this difficulty in its fiscal year 1979 defense authorization bill, which provided advance funding for an LHA.) A third possible ship type for V/STOL is the DDV destroyer. At a cost of $810 million for the lead ship, the DDV might not be the most attractive small carrier alternative. Its seakeeping capabilities are uncertain, and its design may yet be subject to considerable modification, with possible accompanying increases in cost. Of the programs associated with the three ships, the LHA program is the least costly. Because the LHA is the largest of the three units, it probably also provides the greatest assurance of survivability in combat. On the other hand, it would enter the fleet considerably later than would converted LPH V/STOL ships. If the Congress wishes to introduce naval V/STOL as quickly as possible, it might prefer the LPH conversion/LHA procurement program despite its additional cost of $90 million over that of an LHA alone.

A Congressional decision to forego procurement of an additional carrier would not necessarily affect the carrier Service Life Extension Program (SLEP). That program would maintain the carrier force level at 11 ships. The program would only be curtailed if it were demonstrated that still lower carrier force levels could carry out the Navy's required wartime and peacetime missions. On the other hand, a Congressional decision

against procuring another carrier would have important implications both for escort and for tactical air programs.

If the Congress views naval missions as primarily defensive in a worldwide war, it could significantly reduce AEGIS procurement for fiscal years 1980-1984. AEGIS DDG-47s would only be required to defend carriers against large bomber and missile attacks when threatened by Soviet forces. A defensive posture would call for seven carriers to protect the sea-lanes, with the remainder of the force either in overhaul or pursuing ancillary supportive missions. Nine AEGIS ships would be required to support the carriers protecting convoys. (Two of these ships would allow for DDG-47 overhaul.) It is not clear, however, that the existence of two additional carriers as a hedge against unforeseen demands calls for procurement of additional AEGIS ships, at a cost of more than $800 million each, as a further hedge against air attacks on carriers. Carriers would in any event be protected by improved Tartar and Terrier systems. Indeed, the Administration has requested funding for two Tartar destroyers, at a cost of more than $600 million 6/ and is planning a new class of destroyer escorts, which will cost approximately $600 million each. 7/ Onboard last-ditch defense systems and interceptors on combat air patrol would also protect the carrier forces. The additional cost of these ships appears excessive given the undefined nature of the requirements for them. 8/

With respect to naval aviation, a decision not to procure another carrier would lower interceptor and attack aircraft requirements by two squadrons each. Given an emphasis on defensive sea control, the F-14 force would be reduced to 14 squadrons, to

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6/ These ships are included in the revised fiscal year 1979 supplemental request attached to the fiscal year 1980 budget submission.

7/ Information provided to CBO by the U.S. Navy, February 7, 1979.

8/ Strictly speaking, the argument for a lower DDG-47 force applies to Option I as well. Option I retains the higher force level in order to remain consistent with the current DoD five-year program.

support seven carriers that could be required for sea control in a worldwide war. The remaining four carriers could be outfitted with F-18s, resulting in a two-squadron increase of the F-18 requirement over the current DoD request. As a result, F-14 procurement could be terminated after fiscal year 1980, and the 1980 costs could be reduced by the $115 million that has been budgeted for advanced procurement in following years.

Congressional support of an AV-8B program in conjunction with procurement of small air-capable ships would have implications beyond the immediate applicability of V/STOL for presence missions. Rapid introduction of V/STOL into the fleet would enable the Navy to operate V/STOL in a variety of conditions and to assess with greater confidence the demands and possibilities of this technology for maritime applications. Furthermore, it would add impetus to the accelerated introduction of a more capable, supersonic V/STOL plane into fleet operations, possibly by the late 1980s. Finally, procurement of the AV-8B for the Navy would enable the Marines to procure the plane as well. Indeed, procurement of the AV-8B for naval forces would only be feasible, in terms of cost, if it were part of a larger purchase. No more than 48 V/STOL aircraft (permitting 20 operational planes) would be needed to support two LPH units. The Marine program called for 336 aircraft, however. A combined program would significantly reduce the unit cost of each aircraft. 9/ The costs associated with an accelerated AV-8B program would amount to $202 million in fiscal year 1980 and $246 million in fiscal

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9/ Secretary of Defense Harold Brown recently stated before the Senate Committee on Armed Services that the Marine AV-8B program has been terminated primarily on the grounds that other naval aircraft should take priority in the five-year budget plan. See "Senators Criticize Brown on Harrier, Carrier," Aerospace Daily (January 26, 1979), p. 141. If V/STOL were introduced as a Navy plane, however, the argument against the AV-8B would disappear. Cost-effectiveness comparisons with the A-18, which currently is programmed for the Marines in place of the AV-8B, have proved inconclusive, and the Marines strongly prefer the V/STOL alternative. See General Accounting Office, Is the AV-8B Advanced Harrier Aircraft Ready for Full-Scale Development?, pp. 7-8, 11.

year 1981 for full-scale development funding and $557 million (including $117 million in development funding) in fiscal year 1982 (all constant 1980 dollars), when the first 12 production aircraft would be procured. 10/

Table 7 summarizes one version of a "defensive sea control/altered peacetime posture" option. It includes procurement of an LHA, the least costly small carrier option; homeporting a carrier at Guam, to enhance flexibility; procurement of a conventional AEGIS force; procurement of appropriate numbers of F-14, F-18, and AV-8B aircraft; and accelerated funding for advanced V/STOL research. The cost in fiscal year 1980 would amount to $2.2 billion; for the five-year period, it could total $18.9 billion. The 1980 cost of this option would be about $2 billion less than Option I; its five-year cost would be $2.8 billion less than that of Option I.

OPTION III: IMPROVING THE NAVY'S OFFENSIVE SEA CONTROL CAPABILITY AND OPERATIONAL FLEXIBILITY

The Congress may elect to accept the Navy's view that a twelfth carrier should be added to the fleet to enhance its offensive capability, particularly in Pacific combat operations during a worldwide war. The Congress may also wish to reorient naval peacetime operations in the Pacific and Indian Ocean regions in order to provide the Navy with more flexibility to respond to shifting balances in both areas. Lastly, it may wish to prompt the introduction of V/STOL aircraft to the fleet in the immediate future. These considerations might lead the Congress to fund a conventionally powered large-deck carrier (CV) and a V/STOL ship and to provide for an additional homeporting arrangement in the Pacific, such as at Guam. Supporting this decision would be Congressional funding for 10 additional AEGIS ships, an all F-14 force, an all A-18 force, and an AV-8B force.

10/ Whether the full cost of the AV-8B program for the Marines exceeds that of an A-18 program depends on funding profiles beyond fiscal year 1984. The issue of whether the AV-8B, with a greater unit cost than the A-18, actually is more cost-effective for specific Marine missions is beyond the scope of this paper.

TABLE 7. OPTION II: EMPHASIZING DEFENSIVE SEA CONTROL IN WARTIME AND A NEW DEPLOYMENT POSTURE IN PEACETIME, SYSTEMS INVESTMENT AND MILITARY CONSTRUCTION COSTS FOR FISCAL YEARS 1980-1984: BY FISCAL YEAR, IN MILLIONS OF FISCAL YEAR 1980 DOLLARS

	1980		1981		1982		1983		1984		Total	
Unit	Number	Cost	Number	Cost	Number	Cost	Number	Cost	Number	Cost	Number	Cost
CVN a/	—	—	—	—	—	—	—	—	—	—	—	0
CVV a/	—	—	—	—	—	—	—	—	—	—	—	0
LPH (conv)	1	45	—	—	1	45	—	—	—	—	2	90
LHA	—	—	1	820	—	—	—	—	—	—	1	820
CV/SLEP	—	50	1	478	—	41	1	427	—	12	2	1,008
DDG-47	—	—	2	1,481	2	1,424	2	1,449	2	1,416	8	5,770
CGN-41 a/	—	—	—	—	—	—	—	—	—	—	—	0
F-14	24	521	—	—	—	—	—	—	—	—	24	521
F-18 A-18	15	1,044	48	1,380	96	1,683	108	1,612	132	1,686	399	7,405
AV-8B b/	—	202 c/	—	246 c/	12	557 d/	24	495	54	763	90	2,263
V/STOL R&D	—	50	—	142	—	135	—	170	—	258	—	755
Military Construction/Guam	—	250	—	—	—	—	—	—	—	—	—	250
Total Cost		2,162		4,547		3,885		4,153		4,135		18,882

a/ Not included in this option.

b/ Assumes buy of AV-8B for the Marine Corps, with a full Navy buy by 1984.

c/ Research and development funding and initial production costs.

d/ Includes $117 million for research and development funding.

Adding a Kennedy-class large-deck carrier to the fleet at a cost of $1.77 billion would enable the Navy to achieve at least 50 percent more firepower than it could from a mid-sized CVV, 11/ at a cost that would be some 40 percent greater over a 30-year life cycle for carrier and air wing, but only $90 million more in initial procurement terms. Given approximately equivalent cost-effectiveness between the two carrier variants, the desire to maximize total force firepower militates in favor of a Kennedy-class carrier. This contrasts with the situation outlined in Option I, which calls for a "filler ship." In that case, presence, not effectiveness, determines the decision in favor of the less costly unit. 12/

Procurement of V/STOL ships--such as two LPHs (with an LHA for the Marines)--and homeporting would further add to the flexibility of the carrier force. Large-deck carriers could increase the scale of their operations in high-threat areas, while two V/STOL ships, with one homeported at Guam, could provide full-time U.S. presence in the relatively lower-threat region of the Indian Ocean and southwest Pacific. Conversely, the V/STOL ships would be available to support carrier operations in a worldwide war, either as part of an offensive strike force or as a patrol unit in a less threatening area, thereby freeing a carrier from that area for the strike mission.

An offensive posture would justify procurement of an AEGIS force of 12 ships. AEGIS would be required to enhance carrier AAW

11/ The CVV would carry between 50 and 60 aircraft; a Kennedy-class carrier could carry between 80 and 90 aircraft. Life-cycle costs for a Kennedy-class carrier and air wing amount to $19.2 billion; for a CVV carrier and air wing, $13.6 billion.

12/ Procurement of a CVV is not inconsistent with an offensive Navy posture, since a CVV could be assigned defensive missions while large-deck carriers conducted offensive operations. Nevertheless, procurement of a large-deck carrier enhances the flexibility of offensive naval operations; a CVV would tend to be restricted to defensive missions.

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as strike forces approached the Soviet Union, so that carriers could dispose of the air threat more quickly and launch their offensive operations.

Emphasis on enhancing carrier capabilities for offensive sea control missions in wartime would be reflected in aircraft procurement choices as well. Offensive sea control in a major war would call for an all F-14 fighter force to defend carriers against bombers that would attack them as they approached the Soviet homeland. F-14 procurement could therefore be increased to its fiscal year 1978 level of 44 units annually. This would permit entry into the fleet of 24 squadrons in the time currently programmed for the entry of 18 squadrons. F/A-18 procurement for the Navy, on the other hand, could be limited to the A-18 variant. 13/

Procurement of small air-capable ships would call for funding of the AV-8B program as well. As noted above, the capabilities of V/STOL could be tested in a variety of conditions and could spur the accelerated introduction of more advanced V/STOL types. In addition, AV-8B attack planes could supplement the Navy's offensive power and enhance its ability to devote conventional take-off and landing aircraft to demanding missions, since the V/STOL aircraft and ships would operate in less threatening areas.

Table 8 indicates that the procurement cost of this "offensive, flexible" Navy package could amount to $5.2 billion in fiscal year 1980 and $26.7 billion for the entire five-year period. The five-year costs of this option would exceed those of Options I and II by $5.8 billion and $7.8 billion, respectively.

The aircraft procured in this option would also be more expensive. An all F-14/all A-18 AV-8B force would be considerably more costly than an equivalently sized force mix of F-14s, F-18s, and A-18s or an F-14, F/A-18, and AV-8B force. The procurement cost of the F-14/A-18 option would amount to $2.0 billion for fiscal year 1980 and $12.5 billion for the five-year

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13/ For a discussion of whether the A-18 is cost-effective for offensive sea control operations, or indeed in Third World situations, see Appendix A.

TABLE 8. OPTION III: EMPHASIZING NAVY OFFENSIVE CAPABILITY AND PEACETIME FLEXIBILITY, SYSTEMS INVESTMENT AND MILITARY CONSTRUCTION COSTS FOR FISCAL YEARS 1980-1984: BY FISCAL YEAR, IN MILLIONS OF FISCAL YEAR 1980 DOLLARS

	1980		1981		1982		1983		1984		Total	
Unit	Number	Cost	Number	Cost	Number	Cost	Number	Cost	Number	Cost	Number	Cost
CV (Kennedy)	1	1,772	—	—	—	—	—	—	—	—	1	1,772
CVN a/	—	—	—	—	—	—	—	—	—	—	—	0
CV/SLEP	—	50	1	478	—	41	1	427	—	12	2	1,008
DDG-47	1	825	2	1,481	2	1,424	3	2,172	2	1,416	10	7,318
CGN-41 a/	—	—	—	—	—	—	—	—	—	—	—	0
LPH (conv)	1	45	—	—	1	45	—	—	—	—	2	90
LHA	—	—	1	820	—	—	—	—	—	—	1	820
F-14	44	988	44	1,018	44	1,030	44	1,026	44	1,006	220	5,068
F-18 / A-18	15	1,044	48	1,380	96	1,683	108	1,612	132	1,686	399	7,405
AV-8B b/	—	202 c/	—	246 c/	12	557 d/	24	495	54	763	90	2,263
V/STOL R&D	—	50	—	142	—	135	—	170	—	258	—	755
Military Construction/Guam	—	250	—	—	—	—	—	—	—	—	—	250
Total Cost		5,226		5,565		4,915		5,902		5,141		26,749

a/ Not included in this option.

b/ Assumes buy of AV-8B for the Marine Corps, with a full Navy buy by 1984.

c/ Research and development funding and initial production costs.

d/ Includes $117 million for research and development funding.

period fiscal years 1980-1984. This compares to aircraft procurement costs of $11.4 billion in Option I and $7.9 billion for the same aircraft in Option II.

OPTION IV: IMPROVING THE NAVY'S OFFENSIVE SEA CONTROL CAPABILITY AND MAINTAINING CURRENT PEACETIME POSTURE

The Congress may accept the Navy's position that offensive sea control is essential to sea-lane protection in a major war and that the carrier is critical to the success of the offensive sea control mission. Furthermore, the Congress may prefer to take steps to enhance the carrier's potential for peacetime missions without adjusting the current posture. Lastly, it may be skeptical of the contribution that V/STOL aircraft could make to fleet operations in the near term. It could then choose to provide funding for a fifth nuclear carrier (CVN) for the Navy, at a cost of $2.2 billion, 14/ as well as substitute five nuclear cruisers (CGN-41) for conventional destroyers for the force of 12 AEGIS ships described in Option III.

Supporters of the nuclear-powered carrier would argue that its greater cost over a conventional large-deck carrier would be offset by its ability to carry 50 percent more ordnance and operate for longer periods without replenishment. They would argue that V/STOL effectiveness, even in low-threat areas, is not sufficiently credible to justify a combination of a Kennedy-class carrier and a V/STOL ship in place of a large nuclear carrier, if offensive capabilities are to be enhanced.

Nuclear-powered ships could improve the Navy's maritime offensive capabilities. They would permit the formation of five all-nuclear task forces that would add considerable flexibility to naval operations. If all five nuclear carriers were deployed in the Pacific during wartime as well as peacetime, they would represent a credible threat to Soviet installations on the Kamchatka Peninsula. Such a threat could probably bolster Japanese

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14/ Although the cost of a CVN is $2.6 billion, funds already expended for nuclear components would lower the marginal cost of an additional Nimitz-class ship to $2.2 billion.

support of Western aims and could, perhaps, ensure the benign neutrality of China in a worldwide conflict.

During peacetime, the ability to sustain maximum speeds over long distances would permit the carriers to cover larger tracts of ocean or to remain in the Indian Ocean for somewhat longer periods than currently is the case. A move to all-nuclear task forces could thus minimize the need for less capable V/STOL ships, even in terms of peacetime requirements.

Conventional take-off aircraft choices would not be affected by choosing a nuclear-powered carrier. But since V/STOL ships are not included in this option, no AV-8Bs would be purchased. As a result, the total cost of Navy aircraft, while higher than that of Options I and II, would be lower than that of Option III, reflecting the absence of an AV-8B program. Table 9 indicates that the costs of this option could amount to $6.4 billion in fiscal year 1980 and $25.7 billion for fiscal years 1980-1984.

CONCLUSION: A MOSAIC OF OPTIONS

In making its budgetary decisions, the Congress usually focuses on specific items. The purpose of outlining the preceding four alternatives is to indicate that the choice of specific items in the budget can be linked to an overall pattern: a conception of how the Navy might develop during the remainder of this century. Table 10 presents the effect of each option on naval ship and aviation levels in 1995, when all programs addressed in this paper will have been completed. The specific components of these alternatives are not hard and fast, however. Indeed, the alternatives are not mutually exclusive. Elements of the different options could be combined to provide hedges against specific Congressional concerns about the future effect of naval forces on the international scene, while at the same time permitting a more gradual change in the direction of naval force programming. In considering the range of choices for naval force enhancement, the Congress will be addressing the role of the Navy in national strategy until the end of this century. Its view of that role should determine its choices of specific ship and tactical aviation programs for the upcoming fiscal years.

TABLE 9. OPTION IV: IMPROVING THE NAVY'S OFFENSIVE SEA CONTROL CAPABILITY AND MAINTAINING CURRENT PEACETIME POSTURE, SYSTEMS INVESTMENT COSTS FOR FISCAL YEARS 1980-1984: BY FISCAL YEAR, IN MILLIONS OF FISCAL YEAR 1980 DOLLARS

	1980		1981		1982		1983		1984		Total	
Unit	Number	Cost	Number	Cost	Number	Cost	Number	Cost	Number	Cost	Number	Cost
CVV a/	—	—	—	—	—	—	—	—	—	—	—	0
CVN	1	2,558	—	—	—	—	—	—	—	—	1	2,558
LHA a/	—	—	—	—	—	—	—	—	—	—	—	0
LPH (conv) a/	—	—	—	—	—	—	—	—	—	—	—	0
CV/SLEP	—	50	1	478	—	41	1	427	—	12	2	1,008
DDG-47	1	825	1	741	2	1,424	2	1,449	—	—	6	4,439
CGN-41	1	950	1	900	1	875	1	850	1	850	5	4,425
F-14	44	988	44	1,018	44	1,030	44	1,026	44	1,006	220	5,068
F-18 / A-18	15	1,044	48	1,380	96	1,683	108	1,612	186	2,180	453	7,899
AV-8B a/	—	—	—	—	—	—	—	—	—	—	—	0
V/STOL R&D	—	17	—	45	—	65	—	88	—	131	—	346
Total Cost		6,432		4,562		5,118		5,452		4,179		25,743

a/ Not included in this option.

TABLE 10. 1995 FORCE LEVELS RESULTING FROM ALTERNATE BUDGET OPTIONS

	Options			
	I	II	III	IV
Active CTOL Carriers				
Large-Deck Nuclear-Powered Carriers	4	4	4	5
Large-Deck Conventional Carriers	7	7	8	7
Mid-Sized Carriers	1	-	-	-
Total Active CTOL Carriers	12	11	12	12
V/STOL Carriers	-	2	2	-
Conventional AEGIS Escorts	12 a/	9	12 a/	7
Nuclear AEGIS Escorts	-	-	-	5
F-14 Carrier Wing Equivalents	9	7	12	12
F-18 Carrier Wing Equivalents	3	4	-	-
AV-8B V/STOL Carrier Wings	-	2	2	-

a/ Assumes additional DDG-47 procurement after fiscal year 1984.

APPENDIXES

APPENDIX A. THE A-18/A-7E EFFECTIVENESS ANALYSIS

This appendix provides a detailed description of the A-18/A-7E effectiveness analysis mentioned in Chapter IV. First, it summarizes the structure and conclusions of the model. Next, it provides a detailed rationale for a number of assumptions made in the model. Finally, it describes the equations used to generate the effectiveness ratios on which the text's assertions about cost-effectiveness are based.

A SUMMARY OF THE MODEL AND ITS RESULTS

Table A-1 presents ratios of the ordnance tonnage deliverable by equal-deckspace forces of A-7Es and A-18s at various levels of attrition. Two assumptions are fixed in computing these ratios:

- o A-18 survivability advantage of 2.75: enemy defenses that shoot down 10 percent of an A-18 force could shoot down 27.5 percent of an A-7E force. 1/ (2.75 is the mean of the 2.5 to 3.0 estimate provided to CBO by the Navy.) 2/
- o Three sorties per aircraft before replacement: every surviving available aircraft in each force is assumed to be exposed to enemy air defenses on three raids before

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1/ Throughout the analysis, it is also assumed that two-thirds of attack aircraft losses are incurred before ordnance has been delivered. The historical validity of this assumption is unclear; most aircraft tend to be shot down over the target area. It is clear, however, that, compared to any lesser fraction, the two-thirds assumption favors the A-18, since it leads to higher ratios of A-18 to A-7 force effectiveness.

2/ For further discussion of how the survivability advantage estimate is used in this analysis, see "An Aside on Survivability" below.

TABLE A-1. RATIO OF CUMULATIVE TONNAGE DELIVERABLE BY AN A-18 FORCE TO CUMULATIVE TONNAGE DELIVERABLE BY AN A-7E FORCE AT VARIOUS LEVELS OF ENEMY ATTRITION AND VARIOUS LEVELS OF A-18 AVAILABILITY ADVANTAGE, ASSUMING THAT NO MORE THAN THREE SORTIES ARE SCHEDULED FOR EACH SURVIVING ATTACK AIRCRAFT BEFORE REPLACEMENT AIRCRAFT ARE AVAILABLE

A-7E Attrition per Sortie a/		Historical Example of Comparable Attrition Levels	Percent A-18 Availability Advantage b/				
Ratio	Percent		0%	6%	12%	18%	24%
1:5	20		.94	.98	1.03	1.07	1.12
1:10 c/	10		.84	.88	.93	.97	1.02
1:20	5	"Acceptable" Attrition Threshold, World War II and Korea	.79	.84	.88	.93	.97
1:67	1.5	Yom Kippur War (Israeli Air Force A-4s)	.76	.81	.85	.90	.94
1:125	0.8	Yom Kippur War (Israeli Air Force Overall)	.76	.80	.84	.89	.94
1:500	0.2		.75	.80	.84	.89	.93
1:1000	0.1	Southeast Asia 1965-1973 (Navy Losses over North Vietnam)	.75	.79	.84	.88	.93
1:2000	0.05	Southeast Asia 1965-1973 (Navy Losses Overall)	.75	.79	.84	.88	.93

NOTE: The A-18 force is more effective than the A-7E force when the ratio is greater than 1; the A-18 force is more cost-effective than the A-7E force when the ratio is greater than 0.78.

a/ A-7E attrition is assumed to be 2.75 times higher than A-18 attrition.

b/ "Availability Advantage" is here defined to be the percent improvement between the fraction of the A-18 force that can participate in a given strike and the corresponding fraction of the A-7E force.

c/ Attrition levels of 1:20 or more are here characterized as "extremely high." For further discussion of this issue, see item (3) in "Justification of Assumptions Underlying the Model."

additional aircraft are flown aboard the carrier to replace losses incurred in the first raid. 3/

Table A-1 displays ranges of values for two other important parameters. Attrition levels for the A-7E are varied from 1 out of every 5 sorties (20 percent) to 1 out of every 2,000 sorties (0.05 percent). 4/ These levels correspond to A-18 attrition between 1:14 (7.2 percent) and 1:5500 (0.02 percent) losses, given the assumption of an A-18 survivability advantage of 175 percent. A-18 availability advantage percentages, defined as the percent improvement between the fraction of the A-18 force that can participate in a given raid and the corresponding fraction of the A-7E force, are also varied, from 0 percent to the 24 percent level, derived from McDonnell-Douglas data. 5/

Since the purpose of attack aircraft is to deliver ordnance against enemy targets, the ratios in Table A-1 can be interpreted as ratios of A-18 effectiveness relative to A-7E effectiveness. Viewed in this light, the table conveys a surprising message: even if it is assumed that the A-18 enjoys the 175 percent survivability advantage expected by the Navy and the 24 percent availability advantage expected by its prime contractor, the A-7E is more effective than the A-18 except at extremely high levels of attrition. Moreover, if McDonnell-Douglas' prediction regarding availability proves to be overly optimistic, the A-7E will be more effective than the A-18 even at attrition levels well above those normally deemed acceptable as the price of sustained

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3/ In fact, replacement aircraft might be available considerably earlier. For further discussion, see item (1), in "Justification of Assumptions Underlying the Model," below.

4/ Attrition levels above 1:20 have occurred occasionally in the past. A 1:20 ratio can serve as a reasonable upper bound for prolonged A-7E attrition, however. For further discussion, see item (3), in "Justification of Assumptions Underlying the Model," below.

5/ For detailed discussion of the 24 percent upper bound on the A-18's availability advantage and the McDonnell-Douglas scenario from which it was derived, see item (4), in "Justification of Assumptions Underlying the Model," below.

operations in wartime. The conclusion that the A-7E is more effective, however, does not necessarily imply that it is more cost-effective.

Another important message conveyed by the table is that the size of the A-18's availability advantage is the most critical factor in determining its effectiveness relative to the A-7E. This can be seen by considering the sensitivity of the effectiveness ratios to changes in availability. For example, at an A-18 availability advantage level of 6 percent and an attrition level of 1:500 (0.2 percent), the A-18 force is 80 percent as effective as the A-7E force. If the level of attrition increases 25-fold to 1:20 (5 percent), the effectiveness ratio changes only 4 percentage points, to 84 percent. A change of the same magnitude occurs if the A-18's availability advantage merely doubles, from 6 percent to 12 percent.

This information suggests that the A-18 could prove to be a less effective attack aircraft, even if it achieves marked improvements in availability over the A-7E. Since the F-18 will enter Navy and Marine Corps service before the A-18, the Congress may wish to follow its progress carefully to see whether it achieves the advertised levels of maintainability and reliability. If the F-18 does not do so, the Congress may wish to consider programs that hedge against the A-18's decreased effectiveness relative to the A-7E.

JUSTIFICATION OF ASSUMPTIONS UNDERLYING THE MODEL

Several assumptions made in constructing the model are set forth below, followed by a discussion that illustrates the rationale behind each:

(1) Before the fourth sortie scheduled for each surviving attack aircraft, additional aircraft can be made available to replace the losses suffered by an attack carrier in wartime.

In a war with the Soviet Union, offensive strikes against heavily defended bases would probably require several carriers. A number of days would elapse between the time that it was decided to prepare for strike operations and the time that carriers

would have assembled and moved to positions from which strikes could be launched. During this time, other attack aircraft could be flown to bases within range of the strike forces. Aircraft could then fly to the engaged carriers in a matter of hours. 6/ Even if all carrier attack planes were scheduled to fly three sorties during the carrier's 12-hour operating day, the losses from the first strike might well be replaced before the third scheduled sortie of the attack force was launched. 7/ Of course, if carrier attack planes were scheduled for fewer than three sorties per aircraft per day (as in the scenario considered by McDonnell-Douglas and described in item (4) below), replacement aircraft could take part in operations even before some portion of the surviving force was exposed to enemy attrition for a third time. In such circumstances, the ratios in Table A-1 would be more favorable to the A-7E.

In a lesser war, the task of flying replacement aircraft to the carrier might involve longer ferry ranges, depending on the location of the carriers and the availability of land bases in friendly countries. Other resources are likely to be available, however, since, presumably, not all carriers will be engaged in combat operations. Thus, carriers not engaged in combat

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6/ The A-7E and the A-18 have one-way "ferry" ranges in excess of 1,600 nautical miles and fuel-efficient cruise speeds of approximately 400 nautical miles per hour. These combinations of range and speed mean that both planes could reach any point within carrier aviation striking range of Petropavlovsk (or Murmansk) from existing bases in either the Aleutians or Japan (or England, southern Norway, or Iceland) in four hours or less.

7/ This does not mean that replacement aircraft could necessarily participate in strike operations immediately after landing on the carrier; maintenance might be required that would delay using these planes until the next carrier "day," more than 12 hours later. Nor does it mean that Navy aircraft could easily perform this ferrying task in wartime unless appropriate provisions were made beforehand, such as equipping existing air bases to perform the forward staging role. If such provisions were made, however, timely replacement of attack aircraft should prove feasible.

could be moved within ferry range of the carriers that are engaged. Use of these carriers as en-route stopping points, and of their airborne tankers for aerial refueling, should permit timely replacement of lost aircraft if desirable land bases were unavailable.

(2) Payload is a reasonable measure of effectiveness for the A-18/A-7E analysis.

Questions are sometimes raised about the validity of payload as a measure of effectiveness in attacking point targets in light of the development of precision guided munitions. Nevertheless, payload does appear to be a useful measure of effectiveness for attacks against area targets. Furthermore, both the A-7E and A-18 can carry the same categories of ordnance. Finally, A-18 range/payload performance has been cited by its sponsors in the Navy to demonstrate its greater effectiveness relative to other aircraft, such as V/STOL attack planes.

(3) It is reasonable to characterize sustained A-7E attrition of 1:20 (5 percent) or more as "extremely high."

Analysis of attrition during World War II and the Korean conflict suggests that "average losses of 5 percent per sortie over prolonged periods of high intensity operations have been accepted by operational commanders as the price of sustained operations" where "the criterion of acceptability used is that the operations were continued substantially without changes in scale, tactics, or objectives, despite the losses suffered." 8/ This does not mean that attrition greater than 5 percent was always deemed unacceptable; in several instances, it was not. 9/ Some observers claim, however, that U.S. commands are now likely to break off operations if attrition reaches

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8/ See George Haering, "The Impact of Attrition on Sustained Offensive Air Operations," IRM-29 (Washington, D.C.: Center for Naval Analyses, 1962; processed), pp. 3-4.

9/ Ibid.

2 percent. 10/ Figure A-1 shows that the attrition actually experienced by Navy attack aircraft over North Vietnam is consistent with this assessment. It also shows why it is reasonable to characterize sustained A-7E attrition of 5 percent or more as "extremely high" relative to the recent historical experience of Navy attack aircraft. Of course, such attrition levels might be suffered in a future war. These levels would probably be considered extremely high if sustained over a prolonged period, however, and operations might be discontinued as a result. It is clear that, if the A-18 is in fact 175 percent more survivable than the A-7E, A-18s might be employed in attacks for which A-7Es would not be used because of unacceptably high attrition.

(4) Twenty-four percent can be set as an upper bound in estimating the A-18's availability advantages, although it is unlikely to be borne out by actual performance.

The availability advantage estimate of 24 percent was derived from a McDonnell-Douglas scenario. It is too high for at least three reasons. Two of these reasons are related to the McDonnell-Douglas scenario, so it is worth considering in detail.

McDonnell-Douglas assumed a schedule for strike operations that called for an average of 2.33 sorties by each plane in two strike groups, 12 F-14s/24 A-7Es and 12 F-18s/24 A-18s. The sorties were scheduled over seven launch periods in a 12-hour carrier "day." McDonnell-Douglas estimated that the F-18/A-18 force would meet 99 percent of scheduled launches, while the F-14/A-7E force would meet only 80 percent.

Availability and Deck Cycles. One reason why 24 percent is a high estimate of the A-18's availability advantage over the A-7E is that the assumption of seven launches in a carrier day tends to minimize the contraints that carrier operations impose on launching available planes. In conducting large-scale strike operations, a carrier cannot both launch and recover aircraft simultaneously; it must pass through "deck cycles"

10/ See Peter Borgart, "The Vulnerability of the Manned Airborne Weapon System," International Defense Review, 6 (1977), p. 1065.

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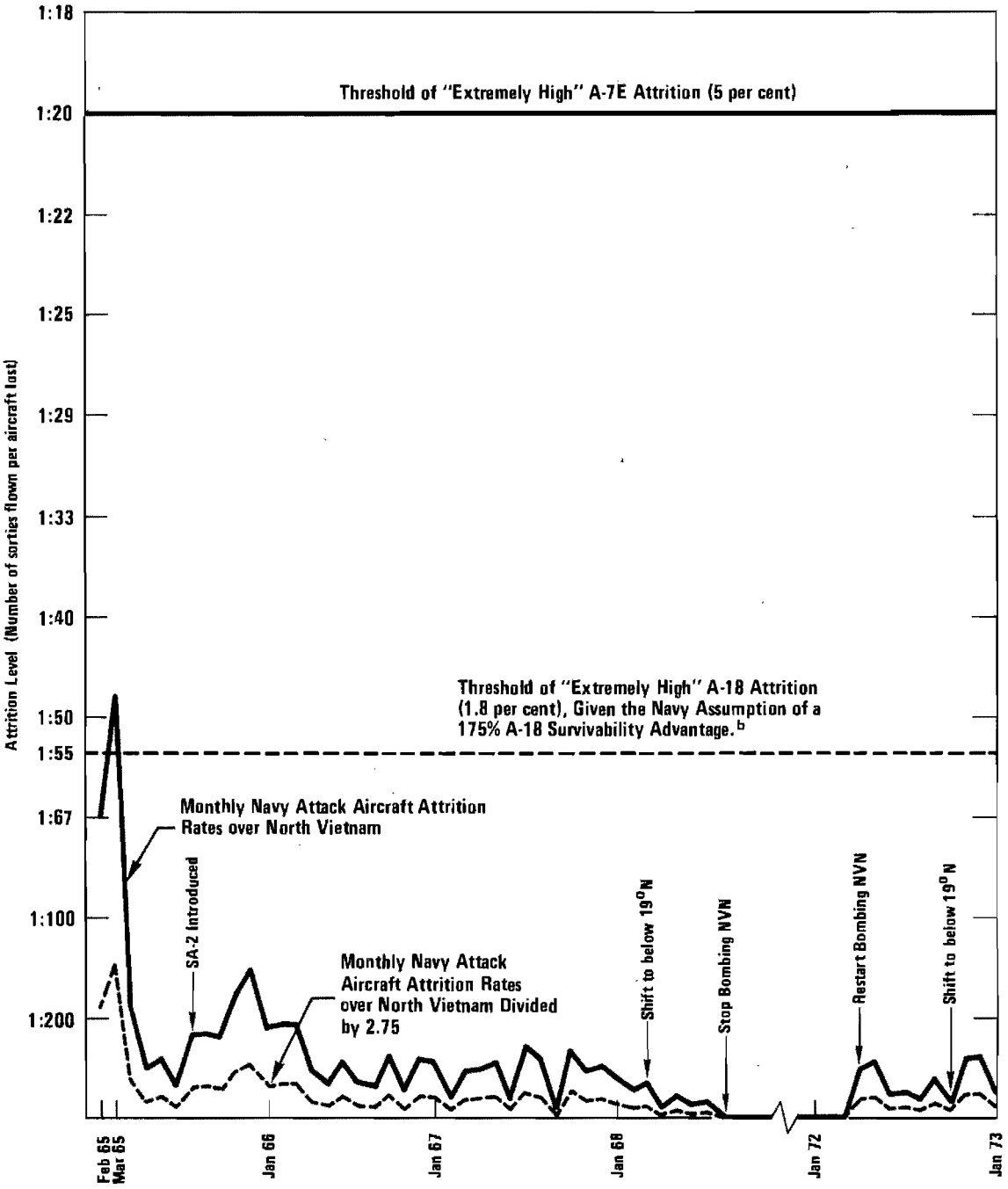
Figure A-1.

Thresholds of "Extremely High" A-7E and A-18 Attrition Compared to Attrition Levels Actually Experienced by USN Attack Aircraft over North Vietnam[a]



[a] Historical data derived from information provided to CBO by U.S. Navy, February 1, 1979.

[b] A 175% A-18 survivability advantage implies that A-7E attrition must be divided by 2.75 to obtain corresponding levels of A-18 attrition. The broken line at 1:55 represents such a divison.

of launch and recovery. As a result, an A-18 cannot necessarily be launched on another mission as soon as it is refueled and rearmed, even though its maintainability and reliability advantages over the A-7E mean that it would be ready to go sooner. Instead, the A-18 must be "fitted" into the cycle. Consequently, a force of A-18s is most likely to achieve a higher number of sorties flown when the carrier goes through several cycles a day, as in the scenario described above. If, as was typical in Vietnam, the carrier launches a large strike group of aircraft only a few times a day, the A-18's availability advantage over the A-7E is likely to be much smaller.

Availability and Operational Readiness Rates. Another problem with relying on the McDonnell-Douglas scenario to predict the A-18's advantage over the A-7E is that the percentages cited in the scenario referred to F-18s and F-14s as well. Navy statistics cited by McDonnell-Douglas suggest that the F-14 has proven to be less reliable and maintainable than the A-7E, however, and therefore very much less reliable and maintainable than the F/A-18 is advertised to be. As a result, it is reasonable to suppose that a disproportionate number of the launches missed by the F-14/A-7E mix in the McDonnell-Douglas scenario were missed fighter launches. Therefore, 24 percent probably overstates the availability advantage claimed for the A-18 over the A-7E. 11/

Availability and Proven Performance. Finally, the 24 percent availability advantage should be regarded skeptically because it corresponds to predictions about F/A-18 reliability and maintainability that have not been proven by experience in the fleet. Moreover, the Navy's experience with other aircraft indicates that the reliability and maintainability estimates associated with the F/A-18 may be overly optimistic. With respect to reliability, for example, the F/A-18 is supposed to achieve between 2.8 and 3.7 mean flight hours between failure (MFHBF). This represents at least a 400 percent improvement over the 0.7 MFHBF performance of the F-4J. In contrast, the corresponding improvement actually achieved by the F-14 over the F-4J has been 0.85 MFHBF rather than 0.7 MFHBF, an increase of approximately

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11/ For the same reason, 24 percent probably understates the advantage claimed for the F-18 over the F-14.

21 percent. 12/ With respect to maintainability, the F/A-18 is promised to require no more than 18 mean maintenance hours per flight hour (MMH/FH), which is a 38 percent improvement over the MMH/FH performance of the A-7E and a 61 percent improvement over the MMH/FH performance of the F-4J. The actual experience of the F-14 again casts doubt on whether newer fighters can achieve the hoped for improvements over the F-4J. A report prepared by the Naval Weapons Engineering Support Activity observes: "Despite the fact that maintainability was a key design criterion for the F-14, its maintenance manhours per flight hour have remained higher . . . than those of the F-4J it replaces." 13/

AN ASIDE ON SURVIVABILITY

Three issues relevant to aircraft survivability were not treated in the text and merit brief discussion here.

Pilot attrition and its impact on the continued ability of the United States to fight was not explicitly discussed because the Navy equips its squadrons with more pilots than aircraft. Therefore, the Navy will run out of planes before it runs out of pilots.

The importance of aircraft survivability in saving the lives of Navy pilots was not explicitly considered. The advisability of procuring a more survivable attack plane in order to save pilots' lives depends on the cost of doing so and on the prospects for saving lives by paying those costs (in money or effectiveness) in

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12/ F/A-18 advocates say that the aircraft's markedly better maintainability and reliability characteristics are the result of considerable effort to design these characteristics into the aircraft and that no comparable effort to this end was made in designing the F-14. Given historical experience, however, it is questionable that the actual improvement will be as great as presently promised once the F/A-18 joins the fleet.

13/ Naval Weapons Engineering Support Activity, A Prediction of Aviation Logistics Requirements for the Decade 1985-1995 (June 1978), p. 4. (Emphasis added.)

other ways. Evaluation of such alternatives is beyond the scope of this paper; consequently, the A-18/A-7E choice was not examined in this light.

Finally, the analysis does not explicitly consider one relationship between tonnage and attrition that is relevant to effectiveness. When flying against intense air defense, pilots attempt to enhance their chances for survival by tactics (for example, evasive "jinking" maneuvers and releasing ordnance from higher altitudes) that can result in less accurate delivery of bombs. Therefore, it could be argued that a campaign conducted by a force of more survivable attack planes would be more effective than a campaign conducted by a force of less survivable planes that delivered the same amount of ordnance. It is not clear, however, that there is one level of attrition at which a pilot will perform maneuvers which degrade the accuracy of ordnance delivery and another at which he will not. Presumably, both A-7E and A-18 pilots will maneuver so as to ensure their survival when that survival is threatened. The A-18 is assumed to be more likely to succeed in this effort, but this does not necessarily imply that its ordnance will be delivered more accurately than that of the A-7E.

DESCRIPTION OF THE QUANTITATIVE ANALYSIS

The model used to generate Table A-1 can be described by a series of formulas. It is possible to describe the number of planes aboard a carrier at the beginning of a given raid, P_{ti}, as

$$P_{ti} = P_{t(i-1)} - P_{t(i-1)} \left(\frac{1}{AA_t}\right)\left(\frac{L}{S_t}\right)$$

where

P_{ti} = number of planes of type t aboard carrier at beginning of raid i

$P_{t(i-1)}$ = number of planes of type t aboard carrier at beginning of the raid preceding raid i

L = losses per A-7E sortie

S_t = survivability advantage factor for aircraft of type t

$$AA_t = \frac{\text{fraction of A-18 force participating in a given raid}}{\text{fraction of the force of aircraft of type } t \text{ participating in a given raid}}$$

and

$$1 \leq AA_t \leq 1.24$$

$P_{(A-18)}$ = 24 before first raid;

$P_{(A-7E)}$ = 29 before first raid;

$$0.0005 \leq L \leq 0.2$$

$S_{(A-18)}$ = 2.75

$S_{(A-7E)}$ = 1

Similarly, the amount of payload deliverable by the available fraction of the surviving force of type t planes at the beginning of a given raid may be determined using the formula

$$O_{ti} = P_{ti}T_t \left(\frac{1}{AA_t}\right)\left(1 - \frac{.667L}{S_t}\right)$$

where

O_{ti} = units of ordnance delivered by aircraft of type t in the ith raid

$.667L$ = loss factor for aircraft that are shot down before delivering ordnance

T_t = payload capacity factor for aircraft of type t

and

$T_{(A-18)} = 1$

$T_{(A-7E)} = 1.105$

Given these formulas, the ratios displayed in Table A-1 may be found by deriving R_i, the ratio of cumulative payload tonnage that has been delivered by equal-deckspace forces of A-7Es and A-18s after i strikes scheduled for every aircraft in each force, as:

$$R_i = \frac{CO_{(A-18)i}}{CO_{(A-7E)i}}$$

where CO_{ti}, the cumulative payload that has been delivered by a force of aircraft of type t by the end of the ith scheduled strike, is defined as:

$$CO_{ti} = \sum_{j=1}^{i} O_{ti}$$

APPENDIX B. OPTIONS IN CURRENT DOLLARS

The costs of each option in the text were presented in terms of constant fiscal year 1980 dollars. The following tables present Options I to IV in terms of current (inflated) dollars. Inflation rates are those shown in the Department of Defense Systems Acquisition Report of December 31, 1978.

TABLE B-1. OPTION I: EMPHASIZING DEFENSIVE WARTIME MISSIONS BUT MAINTAINING CURRENT PEACETIME POSTURE, SYSTEMS INVESTMENT COSTS FOR FISCAL YEARS 1980-1984: BY FISCAL YEAR, IN MILLIONS OF CURRENT YEAR DOLLARS

	1980		1981		1982		1983		1984		Total	
Unit	Number	Cost	Number	Cost	Number	Cost	Number	Cost	Number	Cost	Number	Cost
CV (Kennedy) a/	--	--	--	--	--	--	--	--	--	--	--	0
CVV	1	1,624	--	--	--	--	--	--	--	--	1	1,624
CVN a/	--	--	--	--	--	--	--	--	--	--	--	0
CV/SLEP	--	50	1	509	--	46	1	516	--	15	2	1,136
LPH (conv) b/	--	--	--	--	--	--	--	--	--	--	--	0
LHA b/	--	--	--	--	--	--	--	--	--	--	--	0
DDG-47	1	825	2	1,576	2	1,615	3	2,624	2	1,822	10	8,462
CGN-41 c/	--	--	--	--	--	--	--	--	--	--	--	0
F-14	24	666	24	734	24	785	24	824	24	844	120	3,853
F-18 / A-18	15	1,044	48	1,455	96	1,866	108	1,887	186	2,690	453	8,942
V/STOL R&D	--	17	--	48	--	72	--	103	--	162	--	402
Total Cost		4,226		4,322		4,384		5,954		5,533		24,419

a/ Large-deck carriers, which are not included in this option.

b/ Program for small-deck carriers for V/STOL aircraft, which are not included in this option.

c/ Nuclear-powered AEGIS cruiser, which is not included in this option.

TABLE B-2. OPTION II: EMPHASIZING DEFENSIVE SEA CONTROL IN WARTIME AND A NEW DEPLOYMENT POSTURE IN PEACETIME, SYSTEMS INVESTMENT AND MILITARY CONSTRUCTION COSTS FOR FISCAL YEARS 1980-1984: BY FISCAL YEAR, IN MILLIONS OF CURRENT YEAR DOLLARS

	1980		1981		1982		1983		1984		Total	
Unit	Number	Cost	Number	Cost	Number	Cost	Number	Cost	Number	Cost	Number	Cost
CVN a/	--	--	--	--	--	--	--	--	--	--	--	0
CVV a/	--	--	--	--	--	--	--	--	--	--	--	0
LPH (conv)	1	45	--	--	1	51	--	--	--	--	2	96
LHA	--	--	1	873	--	--	--	--	--	--	1	873
CV/SLEP	--	50	1	509	--	46	1	516	--	15	2	1,136
DDG-47	--	--	2	1,576	2	1,615	2	1,670	2	1,822	8	6,683
CGN-41 a/	--	--	--	--	--	--	--	--	--	--	--	0
F-14	24	521	--	--	--	--	--	--	--	--	24	521
F-18 / A-18	15	1,044	48	1,455	96	1,870	108	1,887	132	2,080	399	8,336
AV-8B b/	--	202 c/	--	259 c/	12	619 d/	24	580	54	942	90	2,602
V/STOL R&D	--	50	--	150	--	150	--	200	--	320	--	870
Military Construction/Guam	--	250	--	--	--	--	--	--	--	--	--	250
Total Cost		2,162		4,822		4,351		4,853		5,179		21,367

a/ Not included in this option.

b/ Assumes buy of AV-8B for the Marine Corps, with a full Navy buy by 1984.

c/ Research and development funding and initial production costs.

d/ Includes $130 million for research and development funding.

TABLE B-3. OPTION III: EMPHASIZING NAVY OFFENSIVE CAPABILITY AND PEACETIME FLEXIBILITY, SYSTEMS INVESTMENT AND MILITARY CONSTRUCTION COSTS FOR FISCAL YEARS 1980-1984: BY FISCAL YEAR, IN MILLIONS OF CURRENT YEAR DOLLARS

	1980		1981		1982		1983		1984		Total	
Unit	Number	Cost	Number	Cost	Number	Cost	Number	Cost	Number	Cost	Number	Cost
CV (Kennedy)	1	1,772	—	—	—	—	—	—	—	—	1	1,772
CVN a/	—	—	—	—	—	—	—	—	—	—	—	0
CV/SLEP	—	50	1	509	—	46	1	516	—	15	2	1,136
DDG-47	1	825	2	1,576	2	1,615	3	2,624	2	1,822	10	8,462
CGN-41 a/	—	—	—	—	—	—	—	—	—	—	—	0
LPH (conv)	1	45	—	—	1	51	—	—	—	—	2	96
LHA	—	—	1	873	—	—	—	—	—	—	1	873
F-14	44	988	44	1,073	44	1,144	44	1,201	44	1,242	220	5,648
F-18 / A-18	15	1,044	48	1,455	96	1,870	108	1,887	132	2,080	399	8,336
AV-8B b/	—	202 c/	—	259 c/	12	619 d/	24	580	54	942	90	2,602
V/STOL R&D	—	50	—	150	—	150	—	200	—	320	—	870
Military Construction/Guam	—	250	—	—	—	—	—	—	—	—	—	250
Total Cost		5,226		5,895		5,495		7,008		6,421		30,045

a/ Not included in this option.

b/ Assumes buy of AV-8B for the Marine Corps, with a full Navy buy by 1984.

c/ Research and development funding and initial production costs.

d/ Includes $130 million for research and development funding.

TABLE B-4. OPTION IV: IMPROVING THE NAVY'S OFFENSIVE SEA CONTROL CAPABILITY AND MAINTAINING CURRENT PEACETIME POSTURE, SYSTEMS INVESTMENT COSTS FOR FISCAL YEARS 1980-1984: BY FISCAL YEAR, IN MILLIONS OF CURRENT YEAR DOLLARS

	1980		1981		1982		1983		1984		Total	
Unit	Number	Cost	Number	Cost	Number	Cost	Number	Cost	Number	Cost	Number	Cost
CVV a/	—	—	—	—	—	—	—	—	—	—	—	0
CVN	1	2,558	—	—	—	—	—	—	—	—	1	2,558
LHA a/	—	—	—	—	—	—	—	—	—	—	—	0
LPH (conv) a/	—	—	—	—	—	—	—	—	—	—	—	0
CV/SLEP	—	50	1	509	—	46	1	516	—	15	2	1,136
DDG-47	1	825	1	789	2	1,615	2	1,750	—	—	6	4,979
CGN-41	1	950	1	959	1	992	1	1,027	1	1,093	5	5,021
F-14	44	988	44	1,073	44	1,144	44	1,201	44	1,242	220	5,648
F-18 / A-18	15	1,044	48	1,455	96	1,866	108	1,887	186	2,690	453	8,942
AV-8B a/	—	—	—	—	—	—	—	—	—	—	—	0
V/STOL R&D	—	17	—	48	—	72	—	103	—	162	—	402
Total Cost		6,432		4,833		5,735		6,484		5,202		28,686

a/ Not included in this option.

GLOSSARY

A-6: Navy/Marine Corps all-weather medium attack aircraft.

A-7E: Navy light attack aircraft currently in service.

A-18: Light attack version of new Navy/Marine Corps fighter/attack aircraft; identical to F-18.

AEGIS: An integrated, computer-controlled air defense system, comprising a network of radars for tracking and targeting enemy projectiles, and associated missiles and missile launchers.

ASW: Antisubmarine warfare.

Attack Aircraft: An airplane employed primarily for air-to-ground missions.

AV-8B: Improved version of Harrier vertical/short take-off and landing attack plane.

AV-8B+: Proposed AV-8B variant with upgraded engines, a medium-range missile, and a radar and inertial navigation system adapted from the A-18.

B-52D: Late-1950s variant of B-52 strategic nuclear bomber; has been employed for conventional long-range bombing missions.

Backfire: New Soviet long-range bomber; can carry air-to-surface missiles for antiship operations.

Badger: Medium-range Soviet bomber; can carry air-to-surface missiles for antiship operations.

CTOL: Conventional take-off and landing. The only ships from which CTOL aircraft can operate are aircraft carriers equipped with catapults and arresting gear.

CVN: Nuclear-powered multipurpose large aircraft carrier.

CVV: Conventionally powered mid-sized aircraft carrier.

DDV: Destroyer converted to carry helicopters and vertical/short take-off and landing aircraft.

F-14: Navy air superiority/fleet air defense fighter/interceptor.

F-15: Air Force air superiority fighter.

F-18: Fighter variant of new Navy/Marine Corps fighter/attack aircraft; identical to A-18.

F-111: Air Force variable-wing ("swing-wing"), long-range, all-weather attack aircraft.

Fighter: An airplane employed primarily for air-to-air missions.

Harpoon: A tactical antiship cruise missile that can be fired from surface ships, submarines, or aircraft.

Harrier: Trade name of Hawker-Siddeley vectored thrust V/STOL fighter/attack plane; termed AV-8 by the Marine Corps.

Interceptor: A fighter aircraft designed for defense against incoming bombers or missiles.

LHA: General purpose amphibious assault ship.

LPH: Amphibious assault ship.

P-3: Land-based antisubmarine patrol aircraft.

Phoenix: Long-range, radar-guided, air-to-air missile.

SLEP: Service Life Extension Program.

Sparrow: Medium-range, radar-guided, air-to-air missile.

SSN: Attack submarine (nuclear-powered).

UE: Unit Equipment; the number of aircraft assigned a squadron or wing.

V/STOL: Vertical/short take-off and landing.

V/STOL "B": Proposed supersonic naval V/STOL fighter/attack aircraft.